Evaluation of NSF's International Research Fellowship Program: Final Report

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This report includes data from the Survey of Doctoral Recipients (SDR). The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusions in this report.

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Executive Summary

> *Effective international S&E partnerships advance the S&E enterprise and energize U.S. innovation and economic competitiveness, but they also have great potential to improve relations among countries and regions and to build greater S&E capacity around the world.*[1]

Over a decade ago, the National Science Board (NSB) highlighted the importance of international collaboration in its call for increased government commitment to promoting international science and engineering (S&E) research and education.[2] The NSB also identified the National Science Foundation (NSF) as having an important leadership role in international S&E research and education activities, specifically in promoting international S&E among early career scientists and engineers.[3]

Among NSF's postdoctoral programs, the International Research Fellowship Program (IRFP) is unique in its emphasis on providing postdoctoral fellows with international research experiences.[4] Established in 1992, IRFP provides financial support to postdoctoral scientists for a research experience abroad lasting from 9 to 24 months;[5] there is no restriction on the geographical location of the hosting institution. IRFP aligns closely with the NSB's call for NSF to support the international science engagement of scientists and engineers.

NSF contracted with Abt Associates to conduct an evaluation of IRFP, to gather evidence about whether the IRFP program has achieved its goal of furthering the collaborative activities and international partnerships of early career STEM researchers. The evaluation found evidence that the IRFP program is meeting its goals, which are to:

- Introduce early career scientists and engineers to opportunities for international research collaboration;
- Build research capacity and global perspective of participants; and
- Forge long-term relationships between U.S. and foreign S&E researchers.

This report presents the findings from the evaluation of IRFP, which was designed to investigate the characteristics of IRFP applicants and their motivations for participation, the host researchers'

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1 National Science Board. 2008. *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise.* NSB-08-4. Arlington, VA: National Science Foundation, p. 1

2 NSB. 2001. *Toward a More Effective Role for the U.S. Government in International Science and Engineering* NSB-01-187. Arlington, VA: National Science Foundation.

3 NSB. 2000. *Toward a More Effective NSF Role in International Science and Engineering.* NSB-00-217. Arlington, VA: National Science Foundation.

4 A list and descriptions of NSF postdoctoral opportunities can be found at http://www.nsf.gov/funding/education.jsp?fund_type=3

5 National Science Foundation. 2006a. IRFP Program Solicitation. Retrieved from http://www.nsf.gov/pubs/2006/nsf06582/nsf06582.html#pgm_desc_txt

motivations for participating in the program, participants' experiences in and perceptions of the program, and outcomes of the program.

The importance of international collaboration cannot be overstated. Researchers and policymakers agree that while the United States remains a leader in S&E research and development, the nation cannot maintain this position without engaging in international collaborations. Promoting international engagement at all levels is crucial to fostering successful research partnerships and developing the next generation of S&E researchers. Providing early career researchers with an opportunity to engage in an international research experience may help them improve their own research capabilities and pursue future collaborations with international colleagues. This, in turn, could lead U.S. researchers to reap benefits such as increased visibility in the research community, access to more substantial funding and resources, and the opportunity to benefit from the expertise of international peers.

Findings from this evaluation demonstrate that individuals derive important benefits from the program, both on an individual and a collective basis. Former fellows and hosts strongly endorsed the IRFP program, and would recommend IRFP to their students and colleagues. IRFP offers an opportunity for interested researchers to develop their international research collaborations early in their careers. The experiences during IRFP seed relationships that often are sustained and that generate international research collaborations across geopolitical boundaries. As such, IRFP has a central role in NSF's efforts to respond the NSB's charge that NSF play a leadership role in international S&E research and education activities, and specifically in promoting international S&E among early career scientists and engineers.

Key Findings

To align with the program goals, the evaluation paid particular attention to the opportunities for international research collaborations, the experiences to develop research capacity and global perspectives, and the relationships between U.S .and foreign researchers. Specifically, the evaluation examined the following questions:

1. Does the extent to which former fellows engage in international collaborations differ from those of unfunded applicants?
2. Do fellows' post-award career activities and job characteristics differ from unfunded applicants?
3. What are the perceived outcomes of program participation?
4. Do the outcomes of program participation extend beyond the direct participants?

The evaluation provides evidence that the IRFP experience leads to greater levels of international research engagement among fellows.

- There are statistically significant and positive differences between fellows and unfunded applicants on the number of international postdoctoral fellowships held.

- IRFP fellows had a larger number of publications with a foreign co-author compared to non-funded applicants, and the percentage of publications with a foreign co-author was also greater for fellows. These differences were statistically significant.

Importantly, this international focus does not come at the expense of research productivity or professional advancement.

- Fellows and their peers were equally likely to hold multiple postdoctoral appointments, and were equally productive researchers, equally likely to hold a faculty rank of assistant, associate, or full professor, and equally likely to be tenured.
- Career outcomes of IRFP fellows, and applicants overall, compare well against national STEM PhD holders on employment, publications, and international collaborations, suggesting that IRFP attracts a talented pool of applicants.

Former IRFP fellows also reported that they reaped positive career outcomes from their participation in IRFP.

- About four-fifths of fellows (79 percent) reported that participating in IRFP had qualified them for a broader range of career options, and 68 percent said that IRFP had made them more competitive for jobs.
- Fellows reported that IRFP had opened up new areas for investigation (71 percent).

The relationships developed during IRFP seed subsequent professional collaborations and activities that endure beyond the fellowship period.

- Nearly three-quarters (71 percent) of IRFP fellows reported that they had made important connections to researchers in their host country.
- Most fellows reported that the fellowships offer opportunities for professional relationships that endure beyond the fellowship period, either through subsequent collaborations with their hosts, and/or additional communications (46 percent each). Half of all former fellows said that participation in IRFP made them more committed to international research collaboration.

Further, the program demonstrates potential to reach beyond the immediate participants.

- More than three-quarters of former IRFP fellows reported that post-fellowship, they taught colleagues, students or peers methods learned during their fellowship (78 percent), and shared resources or tools acquired during this time (75 percent).
- Hosts also served as a mechanism for extending the effects of the program to other scientists. Twenty-five percent of former IRFP hosts reported that a collaboration with a U.S. researcher resulted from their participation in the IRFP program.

Additional Findings

The evaluation was also designed to address the following questions:

5. What are the characteristics of people who apply for and participate in the IRFP program?
6. What motivates individuals to apply for and participate in the program, and what are individuals' experiences during the application process?
7. What are the program experiences of program participants and managers?

Since 1992, IRFP has received 1,660 applications from individuals, with varied backgrounds, interested in pursuing their research in settings abroad.

- IRFP is a fairly selective program, accepting just over one-third (35 percent) of applications overall since its inception, and it has become more competitive over time.
- Nearly half of the proposed research projects were proposed in the life sciences (47 percent), and about one-quarter in the physical sciences (26 percent).
- IRFP applicants proposed research in regions that spanned the globe, although a majority (60 percent) identified locations in Europe.
- Graduate advisors are reported to be supportive of their students' applications; 72 percent of applicants reported their advisors actively encouraged or supported their decision to apply.

The IRFP applicants represent early career scientists with varied motivations for participating in the program, although the motivations reflect the value that these scientists and engineers place on foreign collaborations.

- A large majority of applicants cited the desire to conduct research with a specific person or at a specific institution (87 percent), and to enhance their skills or knowledge as a researcher (82 percent) as the reasons for applying to IRFP. Over half also noted their desire to collaborate with a foreign scientist in general (60 percent) and to enhance their resume (57 percent).
- In selecting a specific host country, applicants were primarily motivated by the presence of a host who was conducting research relevant to their own interests (87 percent), followed by resources at the host institution that were helpful in their research (52 percent).

Funded fellows are hosted by research scientists in foreign institutions, who also express a variety of motives for participating in the program. Specifically,

- Many foreign hosts had prior academic and professional experiences in the U.S., although 66 percent had never hosted a postdoctoral fellow from the U.S.
- The large majority of foreign host scientists (83 percent) reported that they agreed to host fellows because of the specific research projects proposed; the next most commonly reported rationale was an interest in creating an international environment in their research group (60 percent).

Overwhelmingly, participants of the program were satisfied with the program and found the fellowship valuable.

- Former fellows and hosts offer strong endorsement for the IRFP program. All former IRFP fellows would recommend the program to a colleague, and the large majority of hosts (84 percent) would recommend, or have already recommended, to others that they host an IRFP postdoctoral fellow from the U.S.
- Over 90 percent of fellows were somewhat or very satisfied with the quality of research they were able to conduct as part of IRFP (92 percent) and the timing of the fellowship with respect to their career goals (97 percent).
- Over 80 percent of fellows were satisfied with many aspects of their host, including the match between research interests, the host's expertise and contributions to the research, their inclusion in collaborations, and frequency of meetings.
- Hosts noted that IRFP fellows compared favorably to other postdoctoral fellows with whom hosts had worked; 56 percent of hosts were much or somewhat more satisfied with IRFP fellows compared to other postdoctoral fellows, and another 28 percent were equally satisfied.
- Hosts generally strongly agreed or agreed (72 and 24 percent, respectively) that their IRFP fellow had sufficient knowledge and expertise, and that the fellow integrated well with their research group (66 and 26 percent, respectively).

The fellowships provided opportunities for collaborations and advances in research. A majority of fellows credited their IRFP fellowship with allowing them to make substantial advancements in their research, and hosts and fellows agreed they worked collaboratively on important aspects of research projects.

- About two-thirds commented that their IRFP fellowship provided the chance to familiarize themselves with the scientific enterprise in their host site (65 percent) and to make substantial advancements in their research (64 percent).
- Hosts and fellows most commonly cited collaborating on activities that involved developing project ideas and hypotheses, interpreting results, and planning follow-up work.
- Hosts and fellows agreed that fellows worked mostly independently collecting data, carrying out simulations, and keeping records or tracking supplies and resources.

IRFP also offers fellows a broad range of professional opportunities beyond the chance to conduct quality research at their host institution, including opportunities to network with colleagues from other than their host institution, attend lectures in their field, and give talks at their host institution.

- Other professional activities featured prominently in the experiences of many fellows. Specifically, IRFP provided fellows with the opportunity to network with colleagues from institutions outside their host institution (90 percent), attend lectures in their field (89 percent), visit other institutions (89 percent), attend conferences (84 percent), and give talks at their institution (71 percent).

- Fellows also experienced a variety of cultural activities including sightseeing (96 percent) outdoor activities that explore geography (95 percent), museums (89 percent), and festivals or holidays (85 percent).

Most participants did not cite specific challenges, but those that were mentioned illustrate areas that might deserve attention of future fellows or hosts.

- Forty percent of fellows reported no noteworthy difficulties during their fellowship. The most common challenges were related to logistics (32 percent) and language difficulties (20 percent), followed by inadequate access to space or resources (16 percent), and not enough guidance from the host researcher or research group (15 percent).
- Only one-third of hosts reported any challenges experienced in hosting an IRFP fellow. Specific challenges in hosting an IRFP fellow were identified by less than 10 percent of hosts, including noting that the fellow did not devote enough time to the research collaboration (10 percent), and the fellow worked too independently or did not work well as a collaborator (8 percent).

Evaluation Approach

The evaluation employed quasi-experimental impact analyses to compare the outcomes of fellows to those of unfunded applicants, using pre-award characteristics of applicants to mitigate the potential threat of selection bias. To reduce the risks associated with selection bias, the study incorporated propensity score analysis (PSA) to construct groups of awardees and non-awardees that were statistically similar across a number of pre-existing characteristics. A secondary set of comparative analyses between IRFP applicants (and fellows) and a nationally representative sample of STEM doctorates from the Survey of Doctoral Recipients (SDR) was used to situate the outcomes of IRFP program participants and applicants within the national S&E context. The evaluation also used descriptive analyses to explore the pre-award international research experiences and other characteristics of IRFP applicants and host scientists; to understand what motivated STEM doctoral recipients to apply for an IRFP postdoc and what led IRFP host scientists to collaborate with an IRFP fellow; and to describe the experiences of IRFP participants (i.e., fellows and hosts), both during and after the period of the postdoctoral fellowship.

Data for the evaluation were drawn from extant sources, and surveys were administered to collect information from program applicants (both those who received IRFP fellowships and those who did not) and IRFP foreign hosts. Extant data came from NSF's administrative records on applicants and from the Survey of Doctoral Recipients (SDR). The core data for the evaluation were gathered through online surveys completed—from January through March, 2011—by IRFP applicants and hosts.

The target populations for the study included all individuals who had applied to the IRFP program from its inception in 1992 through 2009, as well as the research scientists who served as foreign hosts during this period. Responses were received from 457 IRFP fellows and 582 unfunded applicants; responses rates were 81 percent and 55 percent, respectively, and estimates were adjusted for non-response. Surveys were received from 328 hosts, for a 61 percent response rate.

1 Introduction

> *Effective international S&E partnerships advance the S&E enterprise and energize U.S. innovation and economic competitiveness, but they also have great potential to improve relations among countries and regions and to build greater S&E capacity around the world.*[6]

Over a decade ago, the National Science Board (NSB) highlighted the importance of international collaboration in its call for increased government commitment to promoting international science and engineering (S&E) research and education.[7] The NSB also identified the National Science Foundation (NSF) as having an important leadership role in international S&E research and education activities.[8] A specific area of focus for NSF was promoting "…increased participation in international S&E activities by younger U.S. scientists and engineers from diverse backgrounds, especially those in the early stage of their careers, in order to develop an internationally competitive and globally-engaged S&E workforce."[9]

Within NSF, the Office of International Science and Engineering (OISE) serves as a primary hub for international research opportunities for U.S. scientists and engineers. OISE's International Research Fellowship Program (IRFP) provides international fellowships to early career scientists to further NSF's commitment to support the active engagement of early career STEM researchers in international collaborations.

NSF staff are familiar with successful IRFP projects, and have shared highlights of individual IRFP projects to disseminate program successes more broadly to the S&E community. (See Appendix A for NSF-generated descriptions of some such highlighted IRFP projects). However, rather than relying on anecdotal evidence of program success for making programmatic decisions, NSF sought to systematically gather data on the program through an external evaluation. In August 2009, NSF contracted with Abt Associates to conduct an evaluation of the IRFP, to gather evidence about whether the IRFP program has achieved its goal of furthering the collaborative activities and international partnerships of early career STEM researchers. This report presents the findings from Abt Associates' evaluation, focusing on program applicants over the 1992–2009 time period as well as their foreign hosts.

The evaluation found evidence that the IRFP program is meeting its goals, which are to:

- Introduce early career scientists and engineers to opportunities for international research collaboration;
- Build research capacity and global perspective of participants; and
- Forge long-term relationships between U.S. and foreign S&E researchers.

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6 NSB. 2008.

7 NSB. 2001.

8 NSB. 2000.

9 NSB. 2000, p. 10.

This report presents the findings from this evaluation. Below, the IRFP program is described and situated within recent trends in international scientific research. The report then describes the methodology used to conduct the evaluation (Chapter 2); characteristics of IRFP applicants and their motivations for participation, and the host researchers' motivations for participating in the program (Chapter 3); participants' experiences in and perceptions of the program (Chapter 4); outcomes of the program (Chapter 5); and conclusions and implications of the findings of the evaluation. The appendices included with this report provide additional details: Appendix A presents specific project highlights that NSF has developed, Appendices B through D describe methodological details, Appendix E contains the survey instruments, and Appendix F contains a comparison of IRFP applicants to national data on career outcomes.

1.1 IRFP

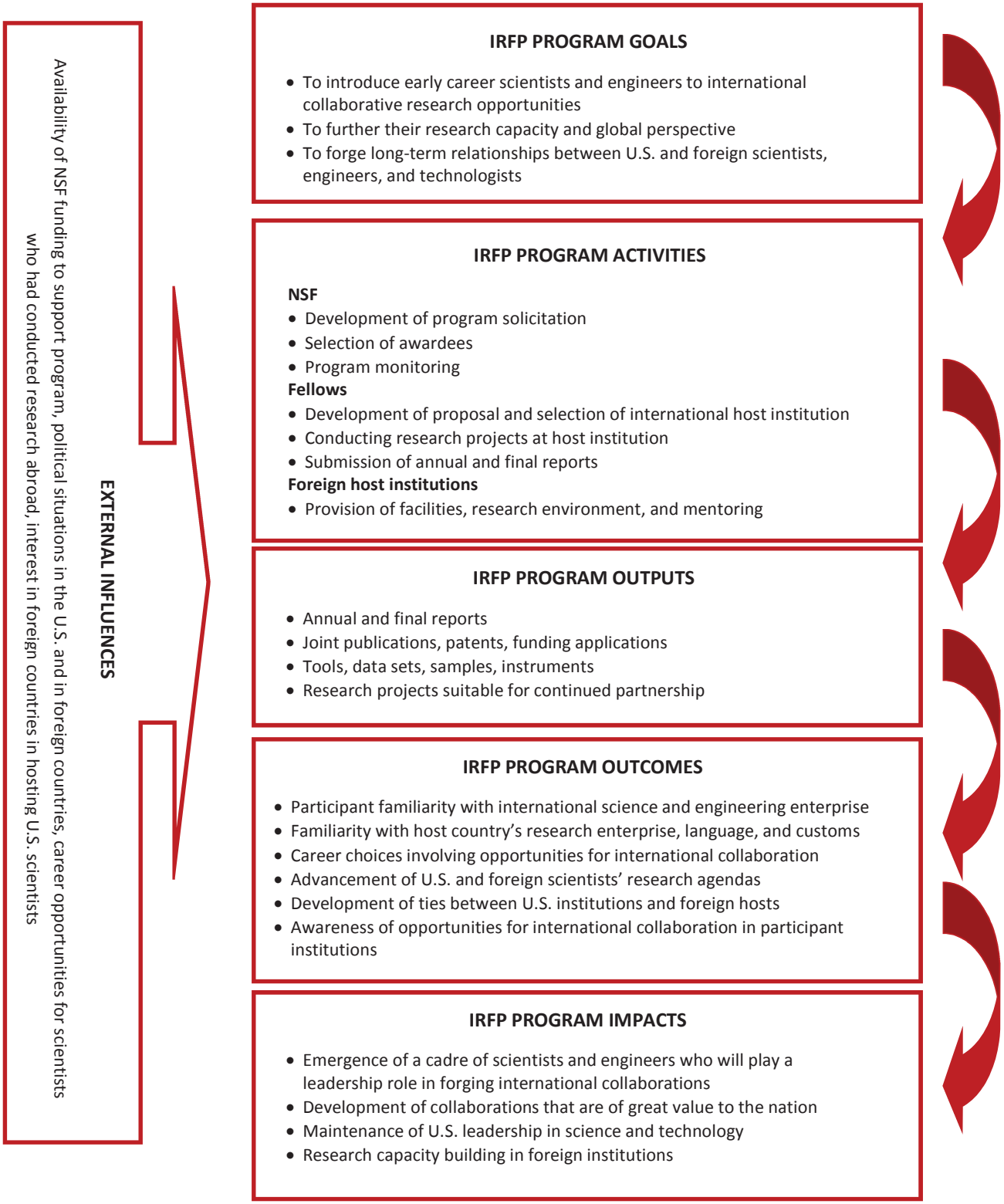
Postdoctoral positions are playing a role in the research development of more PhD graduates. For example, according to data from the Survey of Doctorate Recipients, the numbers of S&E PhD graduates reported having had a postdoctoral position has risen from 31 percent among PhD holders who graduated prior to 1972, to 46 percent among those who graduated from 2002 to 2005.[10] Among NSF's postdoctoral programs, IRFP is unique in its emphasis on providing postdoctoral fellows with international research experiences.[11] IRFP aligns closely with the NSB's call for NSF to support the international science engagement of scientists and engineers.

The program logic model for IRFP (Exhibit 1.1) identifies the links between program processes and outcomes, and helped ground the evaluation in the program's theory. The IRFP program goal is to introduce early career scientists to international collaborative research opportunities that further their research capacity and global perspective, and that forge long-term relationships between U.S. and foreign scientists, engineers, and technologists. The fellows' selections of research topics and appropriate foreign hosts are expected to lead to joint fellow-host publications, better understanding by the fellows of the host country's cultural and academic conditions, and ideally, to continued research collaboration initiated through and persisting beyond the duration of the fellowship experience. In addition to the internal components of the logic model, factors that are outside of the participants' control might shape the program; some of these factors are listed in the model. For example, funding levels allocated to the program each year will affect the number of fellows receiving support. Safety and economic conditions in foreign countries, as well as the level of diplomatic engagement between the United States and other countries, can also influence the fellows' selection of the hosts.

[10] NSB. 2010a. *Science and Engineering Indicators 2010.* NBS-10-01. National Science Foundation: Arlington, VA.

[11] A list and descriptions of NSF postdoctoral opportunities can be found at http://www.nsf.gov/funding/education.jsp?fund_type=3

Exhibit 1.1: IRFP Program Logic Model



Established in 1992, IRFP provides financial support to postdoctoral scientists for a research experience abroad lasting from 9 to 24 months.[12] There is no restriction on the geographical location of the hosting institution; in 2008, for example, analyses of programs records show that 31 fellows resided in 18 countries.

These goals have been fairly stable throughout the program; they have undergone only two small changes since its inception. The wording in the first part of the goal "to introduce scientists and engineers in the early stages of their careers to opportunities abroad" has remained unchanged. The second part of the goal was refined, first in 2003, from "thereby furthering NSF's goal of establishing productive, mutually beneficial relationships between U.S. and foreign science and engineering communities" to "thereby furthering NSF's goal of creating a diverse, competitive, and globally-engaged U.S. workforce of scientists, engineers, and technologists, and well-prepared citizens" and a second time in 2007 from "thereby furthering NSF's goal of creating a diverse, competitive, and globally-engaged U.S. workforce of scientists, engineers, and technologists, and well-prepared citizens" to "thereby furthering their research capacity and global perspective and forging long-term relationships with scientists, technologists, and engineers abroad."

The program has changed in scope since its inception in 1992. For instance, program records show that the number of annual awards has gradually increased from 20 to 35, and the program's funding amount increased from approximately $1 million in 2000 to almost $3.5 million in 2009. Consequently, the average IRFP award amount gradually increased from $50,000 in 1992 to $150,000 in 2009. Applications have always been accepted once every year, though application deadline dates have ranged from September through November. The fellowship period has remained 9 to 24 months.

1.2 Globalization of Science and Engineering and International Collaboration

International research partnerships are increasingly important to advancing knowledge and discoveries in science, technology, engineering, and mathematics (STEM) fields and for addressing problems of a global nature. A decade ago, the NSB noted that "international boundaries have become considerably less important in structuring the conduct of research and development" in S&E fields.[13] Ten years later, the globalization of S&E research and education continues. The NSB determined that the importance of these trends, as well as the associated opportunities and challenges for the U.S., warranted a publication that highlighted the globalization of science and engineering research.[14]

Further, the potential of science policy and science diplomacy to meet international challenges was the focus of a workshop convened by the Committee on Global Science Policy and Science

[12] NSF. 2006a.

[13] NSB. 2001, p.12

[14] NSB. 2010b. *Globalization of science and engineering research: A companion to science and engineering indicators 2010*. NBS-10-3. Arlington, VA: National Science Foundation.

Diplomacy of the National Research Council.[15] Participants discussed the importance of international science engagement and global science cooperation; they noted the importance of providing opportunities and incentives for U.S. researchers to engage in science in an international arena.[16]

While recent data emphasize that the U.S. is still a major global force in S&E education, research, and investment, other countries are increasing their competitiveness in these areas. The 2010 *Science and Engineering Indicators* report illustrated that the S&E human capacity of foreign countries continues to grow.[17] For instance, other countries are increasingly competing with the U.S. for foreign students, and top student destinations include countries such as the United Kingdom, Germany, and France; in fact, the proportion of foreign students in the U.S. decreased from 25 percent in 2000 to 20 percent in 2006.[18] Additionally, other countries are producing more S&E graduates than the United States; of the more than 4 million first university S&E degrees awarded worldwide in 2006, 21 percent were earned by students in China, 19 percent were awarded to students from the European Union, and only 11 percent of these degrees were earned by students in the United States.[19]

Data also show that there has been growth in foreign nations' S&E workforces that can compete internationally. For instance, between 1997 and 2007 the estimated number of S&E researchers in the United States grew by 40 percent to reach approximately 1.4 million. However, over the same time period, the number of S&E researchers in China grew by 173 percent to also reach 1.4 million.[20] Additionally, while the U.S. remains the leader in S&E research and development expenditures (accounting for 33 percent of total spending), countries such as China have begun to invest large amounts of money into their own research and development (R&D) expenditures (averaging 19 percent annually over the past decade), and the U.S. R&D to gross domestic product (GDP) ratio now ranks eighth among economies tracked by the OECD.[21] Finally, while worldwide S&E research article output has grown at an average annual rate of 2.5 percent between 1995 and 2007, the U.S. output has only grown by 0.7 percent. Other countries' rapid growth in S&E fields means they are likely to train S&E researchers who can compete on a global level, as well as attract skilled workers who might have otherwise chosen to work in the U.S.

In light of these recent trends, it has become increasingly important for the U.S. to assume a leadership role in the formation of international research partnerships. It is important for U.S. scientists to fully engage in international collaboration to maintain a prominent role in the global

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15 National Research Council, Committee on Global Science Policy and Science Diplomacy. 2011. U*.S. and International Perspectives on Global Science Policy and Science Diplomacy: Report of a Workshop*. Washington, DC: National Academies Press.

16 NRC. 2011.

17 NSB. 2010a.

18 NSB. 2010a.

19 NSB. 2010a.

20 NSB. 2010a.

21 NSB. 2010a.

research community and gain insight into international research advances.[22] By assuming an active role in international collaborations, the U.S. can expect to reap benefits that might not otherwise be realized. For instance, Luo et al. found that when researchers from the U.S. and the U.K. engaged in collaborations, the impact of their resulting research significantly increased (as measured by citation rates), especially for U.S. corresponding authors.[23] Additional benefits of international collaboration may include increased access to physical resources and funding; additional opportunities to benefit from the expertise of collaborators; and access to populations, records, historical materials, and circumstances that provide "natural experiments."[24] Finally, allowing for international collaboration also serves as a way to facilitate the expansion of U.S. markets and to promote opportunities for international economic exchange.[25]

The promotion of international collaboration also has impacts beyond the United States. As experts note, research and development in S&E fields can be costly, and it is increasingly necessary for countries to "transcend national boundaries in order to be able to fund projects."[26] Additionally, important problems such as terrorist threats, climate change, and disease outbreaks exist, and therefore must be solved, on a global scale. By establishing international networks of scientists, resources can be shared and ideas can be developed, tested, and implemented across traditional boundaries.[27]

Finally, these partnerships can serve as an important tool in broader international diplomacy efforts. As the National Science Board explains, "science and engineering partnerships can strengthen international relationships and…promote basic scientific values such as accountability, meritocracy, transparency, and objectivity."[28] Policymakers also note that the inclusion of developing nations in these collaborative efforts can promote self-sufficiency and encourage international participation in a variety of areas beyond S&E research.[29]

1.3 Programs to Promote International Research and Collaboration

Funding for international science and engineering partnerships is concentrated in a handful of federal agencies: the Department of Defense (DOD), the National Institutes of Health (NIH), and

22 NSB 2001.

23 Luo, J., Flynn, J.M., Solnick, R.E., Ecklund, E.H., & Matthews, K.R.W. 2011. International stem cell collaboration: How disparate policies between the United States and the United Kingdom impact research. *PLoS ONE*, 6(3), e17684

24 Goodnow, J. 2006. The benefits of cross-cultural collaboration. In *International Collaborations in Behavioral and Social Sciences Research: Report of a Workshop* (pp. 47-63). Washington, D.C.: National Academies. Retrieved from www.nap.edu/openbook.php?record_id=12053&page=47

25 NSB. 2001.

26 NSB. 2001.

27 NSB. 2008.

28 NSB. 2008.

29 NSB. 2008

NSF.[30] Among these agencies, NSF is unique in its emphasis on basic science and engineering. Within NSF, a large number of programs that support international partnerships primarily reside in OISE. As part of its activities, OISE administers the International Research Fellowship Program (IRFP), which provides support to postdoctoral scientists (generally a year or two after the receipt of a doctoral degree), for a 9- to 24-month research experience abroad. Another program that aims to promote long-term international collaborative research (also sponsored by NSF) is the Partnerships for International Research and Education (PIRE) program. This program funds proposals from all areas of NSF-supported science in an effort to: enhance research excellence through international partnerships; promote educational excellence via international collaborations; and strengthen U.S. capacity for international engagement. There is no specific budget limit for any PIRE award.[31] NSF also supports programs that facilitate short-term international collaborations; these include the East Asia and Pacific Summer Institutes (EAPSI), which provides support to U.S. graduate students to spend 8–10 weeks over the summer conducting research in one of seven countries in East Asia and the Pacific region;[32] the Pan-American Advanced Studies Institutes (PASI) program (jointly sponsored with the Department of Energy), which funds students or junior researchers to participate in short courses designed to disseminate knowledge and stimulate training and cooperation among researchers from countries in the Americas;[33] and the Catalyzing New International Collaborations program, which provides funding for short-term activities such as planning visits, workshops, initial data-gathering activities, and the development of research networks designed to develop international collaborations.[34]

Of course, other U.S. agencies and organizations recognize the value of international collaborations, and have implemented programs to facilitate the international exchange of S&E research. For instance, the NIH includes the Fogarty International Center, which funds programs to support global health research conducted through international partnerships, builds partnerships between research institutions in the U.S. and abroad, and trains the next generation of scientists to address global health issues.[35] Another example of a U.S. government-funded effort to promote international collaboration is the International Fulbright Science and Technology Award, sponsored by the U.S. Department of State, which allow international participants to complete a PhD in the

[30] NSB. 2008.

[31] NSF. 2006b. Partnerships for International Research and Education (PIRE) (NSF 09-505). Retrieved from http://www.nsf.gov/pubs/2009/nsf09505/nsf09505.pdf

[32] NSF. 2010. East Asia and Pacific Summer Institutes (NSF 10-591) Retrieved from http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5284

[33] NSF. 2006c. Pan-American Advanced Studies Institutes Program (PASI) (NSF 10-517). Retrieved from http://www.nsf.gov/pubs/2010/nsf10517/nsf10517.pdf

[34] NSF. 2006d. Catalyzing New International Collaborations (NSF 11-508). Retrieved from http://www.nsf.gov/pubs/2011/nsf11508/nsf11508.pdf

[35] The John E. Fogarty International Center: U.S. Department of Health and Human Services, National Institutes of Health. (n.d.). Fogarty at 40: Advancing Science for Global Health. Retrieved from http://www.fic.nih.gov/news/publications/fogarty_40th_brochure.pdf

United States. The Science and Technology Award program has awarded grants to 155 students hailing from 69 counties worldwide.[36]

Additionally, foreign governments have also established programs to facilitate collaboration between U.S. and international S&E researchers. For instance, the Research Internships in Science and Engineering (RISE) program, administered by the German Academic Exchange Service, provides funding for undergraduates to engage in a summer research internship. Participants are matched with German PhD students, who serve as their mentors.[37] Another example, the Human Science Frontier Program (HFSP), provides Young Investigators' Grants, which allow researchers who have completed one or two periods of postdoctoral training to direct their own research project (HSFP Research Grants 2011).[38] A final example, the Partner University Fund, was designed to foster educational research networks between the United States and France. The fund supports approximately 40 partnerships by administering three-year grants that can reach up to $80,000 annually.[39]

1.4 Outcomes of International Partnership Programs

Limited research is available on the effectiveness of programs designed to promote international S&E collaboration. However, evaluations of programs similar to IRFP have found that students who participated in these programs reported gaining new knowledge and skills during their international collaboration. Many also reported that they would be likely to engage in international collaborations in the future, perhaps as a result of their international research experience. For instance, an evaluation of NSF's International Research Experience Program, a program for undergraduate and graduate students that ended in 2008, found that students who engaged in an international research experience reported gaining technical, communication, and language skills; developed an appreciation for cultural differences; and felt that their research experience would "create opportunities for future international collaboration."[40] An evaluation of the Research Internships in Science and Engineering (RISE) program reached similar conclusions. The RISE program provides funding for undergraduate students to complete summer internships in German higher education institutions. Researchers found that the majority of RISE student participants developed a greater understanding of German culture, the vast majority reported an increased desire to travel abroad, and about 1 in 4 alumni reported returning to Germany at some point in the future, either to visit or

[36] The International Fulbright Science & Technology Award. Retrieved from http://scienceandtech.fulbrightonline.org/more-about-sat

[37] Institute of International Education. 2009. *Evaluating the DAAD's Research Internships in Science and Engineering (RISE) Program: A Final Report*

[38] Human Frontier Science Program. 2010. Guidelines for Applicants: Award Year 2011. Retrieved from http://www.hfsp.org/sites/www.hfsp.org/files/webfm/Grants/LI2012%20Guidelines.pdf

[39] Partner University Fund. 2011. *A New Generation of Transatlantic University Partnerships.* Retrieved from http://facecouncil.org/puf/wp-content/uploads/2009/10/BrochurePUF20111.pdf

[40] Spencer, D. 2008. *International research experience program: International research opportunities for students at NSF science and technology centers.* Retrieved from http://66.116.177.96/IREP%20Evaluation%20Report.pdf

to pursue work/study opportunities.[41] Finally, an evaluation of NSF's International Research and Education in Engineering (IREE) pilot program also found that program participants, especially graduate and postdoctoral students, reported acquiring new research capabilities, and that they planned to continue collaborations with their international counterparts at the end of their program experience.[42]

1.5 Purpose of This Study

The importance of international collaboration cannot be overstated. Researchers and policymakers agree that while the United States remains a leader in S&E research and development, the nation cannot maintain this position without engaging in international collaborations. Promoting international engagement at all levels is crucial to fostering successful research partnerships and developing the next generation of S&E researchers. Providing early career researchers with an opportunity to engage in an international research experience may help them improve their own research capabilities and pursue future collaborations with international colleagues. This, in turn, could lead U.S. researchers to reap benefits such as increased visibility in the research community, access to more substantial funding and resources, and the opportunity to benefit from the expertise of international peers.

To align with the program goals, the evaluation paid particular attention to the opportunities for international research collaborations, the experiences leading to developing research capacity and global perspectives, and the relationships between U.S .and foreign researchers. Thus, the evaluation was designed to: describe the experiences with the program of IRFP participants; explore the educational and career outcomes of IRFP fellows and how they compare to those of unfunded applicants and to national doctoral degree recipients; and investigate the effects of the programs beyond the direct participants to other scientists and on institutions.

[41] Institute of International Education, 2009.

[42] Flattau, P.E., Lal, B., Laskey, A., & Ford, J. J. 2009. *Portfolio Evaluation of the National Science Foundation's Grants Program on "International Research and Education in Engineering" (IREE).* Washington, DC: Institute for Defense Analyses, Science & Technology Policy Institute.

2 Methodology

It was important for this study to both measure individuals' experiences with the program and to investigate the effects of the program on participants, particularly with respect to their international research collaborations. As detailed below, the study used a mixed methods design, incorporating extant and primary data sources, to answer the specific research questions. This evaluation included both descriptive and comparative analyses. The descriptive analysis provided summary information about the characteristics, experiences, and perceptions of individuals involved with the program, as well as descriptive comparisons of differences between groups or points in time. The main comparative analyses were designed to investigate the effects of the program on participants, and specifically attribute any observed differences to participation in IRFP. Thus, quasi-experimental impact analyses compared the outcomes of fellows to those of unfunded applicants, using pre-award characteristics of applicants to mitigate the potential threat of selection bias. A secondary set of comparative analyses between IRFP applicants (and fellows) and a nationally representative sample of STEM doctorates from the Survey of Doctoral Recipients (SDR) was used to situate the outcomes of IRFP program participants and applicants within the national S&E context.

2.1 Research Questions

This study was designed to evaluate the extent to which NSF's IRFP program contributes to the engagement of postdoctoral S&E researchers in international research collaborations. Specifically, the evaluation investigated the extent to which NSF is achieving program goals by answering the following research questions:

1. What are the characteristics of people who apply for and participate in the IRFP program?
2. What motivates individuals to apply for and participate in the program, and what are individuals' experiences during the application process?
3. What are the program experiences of program participants and managers?
4. What are the perceived outcomes of program participation?
5. Does the extent to which former fellows engage in international collaborations differ from those of unfunded applicants?
6. Do fellows' post-award career activities and job characteristics differ from unfunded applicants?
7. Do the outcomes of program participation extend beyond the direct participants?

2.2 Data Sources

Data for the evaluation were drawn from extant sources, and surveys were administered to collect information from program applicants (both those who received IRFP fellowships and those who did not) and IRFP foreign hosts.

2.2.1 Extant Data

Extant data came from NSF's administrative records on applicants and from the Survey of Doctoral Recipients (SDR). NSF's administrative records on applicants were used to construct the study sample. Existing national data from the SDR were used to contextualize IRFP applicants' and awardees' experiences and outcomes relative to a nationally representative sample of STEM doctorates who have earned a doctorate in a science, engineering, or health field.

2.2.2 Primary Data

The core data for the evaluation were gathered through online surveys completed—from January to March, 2011—by IRFP applicants and hosts. The surveys gathered information about experiences prior to, during, and after the IRFP program. The IRFP applicant survey had some modules that were specific to either unfunded applicants or IRFP fellows. Copies of this survey and the IRFP foreign host survey are included in Appendix E.

2.3 Study Sample

The target populations for the study included all individuals who had applied to the IRFP program from its inception in 1992 through 2009, as well as the research scientists who served as foreign hosts during this period. These samples are described below.

IRFP fellows and unfunded applicants. All individuals who applied to the IRFP program between 1992 and 2009 were included in the IRFP study. Individuals may have applied more than once to the IRFP program, but for the purposes of this study, they were assigned to a single award status as follows: applicants who ever received a fellowship were considered awardees; applicants who never received a fellowship were considered non-awardees. If individuals received more than one award, they were included in the study for their most recent award. Exhibit 2.1 shows the sample size and response rate for the applicant survey.

The universe of study-eligible applicants included 581 awardees and 1079 non-awardees (n=1,660 applicants). Thirty-two applicants (17 awardees and 15 non-awardees) were not eligible for the study and were excluded from the sampling frame.[43] Eliminating these applicants reduced the eligible sample to 1,628 applicants (564 awardees and 1,064 non-awardees). The overall response rate for the applicant survey was 64 percent. Response rates for the two groups were 81 percent (n=457) for awardees and 55 percent (n=582) for non-awardees.

[43] Individuals were excluded for one of the following reasons: individual had participated in a pilot test of the applicant survey; individual was deceased; individual was awarded the IRFP fellowship but declined the award; potential conflict of interest—individual works for NSF; individual did not recall applying for an IRFP fellowship; or inspection of data showed that individual was not eligible to have applied for IRFP or to participate in the study.

Exhibit 2.1: Final Sample Size and Response Rates for the IRFP Applicants Survey

	Overall	Awardees	Non-Awardees
a. Target sample	1,660	581	1,079
b. Final survey sample [a]	1,628	564	1,064
c. Number of completed & partially [b] completed surveys	1,050	460	590
d. Number of completed surveys	1,039	457	582
Response Rates			
e. response Rate (d/b)	64%	81%	55%

[a] 32 individuals were determined to be ineligible for the IRFP study.
[b] 11 respondents were classified as "partial" responders because they had completed less than 15 percent of the questions on the survey.

IRFP hosts. All hosts of eligible awardees who were identified in NSF records were included in the IRFP study. Hosts for whom records were not available were not included. The universe included 557 study-eligible hosts. Twenty-one hosts were not eligible for the study and were excluded from the sampling frame.[44] Eliminating these hosts reduced the eligible sample to 536 hosts. The overall response rate for the host survey was 61 percent (n=328).

Exhibit 2.2: Final Sample Size and Response Rates for the IRFP Host Survey

	Overall
a. Target sample	557
b. Final survey sample [a]	536
c. Number of completed & partially [b] completed surveys	335
d. Number of completed surveys	328
Response Rates	
e. Response rate (d/b)	61%

[a] 21 individuals were determined ineligible for the IRFP study.
[b] 7 respondents were classified as "partial" responders because they had completed less than 5 percent of the questions on the survey.

2.4 Non-Response

An initial step in the analysis was to explore the consequences of survey non-response, which could lead to bias if the former fellows or unfunded applicants who did not participate in the study would have given systematically different responses to the survey than the individuals who did participate in the survey. Two types of non-response were investigated: unit non-response, that is, instances where no survey was completed; and item non-response, where individual items of an otherwise completed survey were missing.

[44] Individuals were excluded for one of the following reasons: individual was deceased; individual was hosting an applicant who was awarded the IRFP fellowship but had declined the award; individual reported not hosting an IRFP fellow; or inspection of data showed that individual was not eligible to participate in the study. Although it is likely that these data were erroneous, it was not possible to verify or correct the information provided.

2.4.1 Unit Non-Response

The overall response rate for both unfunded applicants and fellows was less than 80 percent. To address unit non-response for the applicant survey, information from NSF program records was used to estimate the probability that a person responded to the survey, as a function of baseline characteristics that were available (e.g. proposal score, cohort year, gender). These probabilities were used to create weights that were then used to adjust estimates to alleviate the potential bias[45] due to non-response. This method is described in more detail in Appendix B.

The overall response rate for the host survey was less than 80 percent; however, absent available extant data on hosts, it was not possible to conduct a non-response bias study. Hence findings refer only to the survey respondents, and not to all IRFP hosts.

2.4.2 Item Non-Response

Item non-response refers to information missing on one or more specific items on an otherwise completed survey. Since the amount of missing data on an individual item was modest (less than 5 percent) across all returned surveys, it was assumed that missing data on an item are missing at random; information on missing data is presented in all exhibits in this report. Where appropriate, the study imputed missing covariate values. Outcome variables were not imputed (for more details on specific steps taken, see Appendix B).

2.5 Analyses

A series of analyses were conducted to answer the descriptive, comparative and impact study questions, as described below. The findings from these analyses are described in the next three chapters.

2.5.1 Descriptive Analyses

Most of the research questions were addressed through the use of simple descriptive statistics such as means and percentages, as well as cross-tabulations to illustrate patterns of responses for groups, or the distribution across subgroups of interest.

In general, categorical variables are summarized in terms of the percentage of respondents who indicated a particular response, and continuous outcomes are presented in terms of means. All exhibits include information on the total number of respondents on which percentages or means were computed as well as information on item non-response. Estimates are adjusted using weights to account for unit non-response (to mitigate any potential bias) so that parameter estimates are representative of the IRFP program as a whole.

[45] Note that a large non-response rate does not necessarily create bias. For example, if the non-respondents were similar across the awardees and non-awardees, then the impact estimate would not be biased necessarily; rather, any effect of the program could not be generalized to the non-respondents (i.e., it would create an external validity problem but not necessarily an internal validity issue).

Responses to survey items that include an "other, please specify" with the option for entering text were coded by the study team for classification into one of the existing response options, where possible.

The qualitative data from open-ended survey questions, for example survey items that asked respondents to describe their individual experiences and perceptions, were examined for common themes and standard coding techniques were applied, where appropriate. These open-ended responses are described in the findings sections and used to illustrate specific experiences with the program. These responses provide detailed examples of individual experiences, although one cannot generalize from these data to all respondents as not all respondents necessarily responded to each open-ended question. Thus, what one respondent described could reflect an idiosyncratic perception or a view shared by others who left an open-ended item blank, or chose to emphasize something else in their comments. Moreover, those who chose to write an open-ended response may have had systematically different views than those who chose to leave such items blank.

2.5.2 Impact Analyses

The evaluation was designed to answer the following research questions about the impact of the IRFP award on participants:

- Do fellows' international collaborations and other international activities differ from those of unfunded applicants in frequency, length, and type of activities?
- What are the fellows' post-award career activities and job characteristics? How do these compare to unfunded applicants and the national samples?

The goal of the impact component of the evaluation was to estimate the effect of IFRP on its participants. If a program brings about changes in its participants, then these individuals should have different outcomes, post-participation, than they would have had in the absence of program participation. Although a random assignment study would have allowed a more rigorous test of the causal impact of the IRFP award on its recipients, this design was not feasible (nor, perhaps, desirable) since awardees had already been selected based on the merits of their IRFP proposal. Instead, a quasi-experimental design was used to compare outcomes for IRFP awardees and non-awardees. The primary threat to the validity of a quasi-experiment comes from selection bias, namely, the possibility that pre-existing differences between awardees and non-awardees, rather than the IRFP award itself, are responsible for observed differences in outcomes between the two groups.

To reduce the risks associated with selection bias, the study incorporated propensity score analysis (PSA) to construct groups of awardees and non-awardees that were statistically similar across a number of pre-existing characteristics (e.g., gender, prior international experience, etc.). [46]

[46] PSA is a common quasi-experimental design approach that has been shown to produce unbiased estimates of program effects. See for example Rosenbaum, P., & Rubin, D. 1984. Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association*, 79(387): 516-524; Heckman, J., Ichimura, H., Smith, J., & Todd, P., Characterizing selection bias using experimental data. available from http://www.irp.wisc.edu/initiatives/trainedu/igrfp/readings04/Heckman_Characterizing_selection_bias.p

Subsequent impact models incorporated the results of the PSA. These methods are described in more detail in Appendix C.

For each outcome, the impact of IRFP was estimated for each propensity stratum (controlling for number of years since PhD degree, underrepresented minority status, and gender, and also where applicable number of pre-award publications and field of study); then, the overall treatment effect was calculated by taking an average of the estimated treatment effects weighted by the number of treated observations (i.e., the number of awardees) within each stratum. Exhibits display the adjusted (estimated) means for awardees and non-awardees, the estimated impact, the standard error, and the p-value. For model specifications and standard error calculations, see Appendix C.

It is important to note that the findings described here result from a quasi-experimental analysis that incorporates statistical controls. Although the propensity score analysis is used to control for pre-existing characteristics along which awardees and non-awardees may have differed, there is always a chance that some unmeasured preexisting characteristic, rather than the IRFP award itself, could be responsible for any difference in outcomes between these two groups.

2.5.3 Comparative Benchmarking

The 2006 and 2008 Survey of Doctoral Recipients (SDR) was utilized in this study to compare the IRFP fellows and applicants to a nationally representative sample of science, engineering and health (SEH) doctoral degree recipients on key employment, postdoctoral appointment, and international collaboration variables. For this study, the primary comparison group for IRFP fellows is a propensity-score matched sample of unfunded IRFP applicants. The SDR respondents were used as a *secondary* comparison group to assess how fellows' and all applicants' outcome indicators compare to national averages. SDR indicators most relevant to the study include employment sector and current position, and the nature and extent of collaboration with foreign researchers. The methods used for these analyses are described in more detail in Appendix D.

df; Cook, T., Shadish, W. and Wong, V. 2008. Three conditions under which experiments and observational studies produce comparable causal estimates: New findings from within-study comparisons, *Journal of Policy Analysis and Management*, 27(4), 724-750.

3 Characteristics of Program Applicants and Participants

This chapter describes the characteristics of IRFP applicants, including background characteristics, pre-application international experiences, and motivations for seeking an IRFP award. It also describes whether and how such characteristics differ for unfunded applicants and awarded IRFP fellows. Findings on the applicants' characteristics are drawn from the 1,039 IRFP applicants who completed the applicant survey (457 IRFP fellows, 582 unfunded applicants); estimates have been weighted to adjust for non-response as described above in Chapter 2: Methodology. In addition, this chapter presents information about the IRFP host scientists' reasons for participating in the program, drawing from the 328 completed IRFP host surveys.

Specifically, this chapter answers the following questions:

- What are the characteristics of people who apply for and participate in the IRFP program?
- What motivates individuals to apply for and participate in the program?

3.1 Key Findings

- IRFP is a fairly selective program, accepting just over one-third (35 percent) of applications overall since its inception, and it has become more competitive over time.
- Nearly half of the proposed research projects were proposed in the life sciences (47 percent), and about one-quarter in the physical sciences (26 percent).
- IRFP applicants proposed research in regions that spanned the globe, although a majority (60 percent) identified locations in Europe.
- Graduate advisors are reported to be supportive of their students' applications; 72 percent of applicants reported their advisors actively encouraged or supported their decision to apply.
- A large majority of applicants cited the desire to conduct research with a specific person or at a specific institution (87 percent), and to enhance their skills or knowledge as a researcher (82 percent) as the reasons for applying to IRFP. Over half also noted their desire to collaborate with a foreign scientist in general (60 percent) and to enhance their resume (57 percent).
- In selecting a specific host country, applicants were primarily motivated by the presence of a host who was conducting research relevant to their own interests (87 percent), followed by resources at the host institution that were helpful in their research (52 percent).
- Many foreign hosts had prior academic and professional experiences in the U.S., although 66 percent had never hosted a postdoctoral fellow from the U.S.
- The large majority of foreign host scientists (83 percent) reported that they agreed to host fellows because of the specific research projects proposed; the next most commonly reported rationale was an interest in creating an international environment in their research group (60 percent).

3.2 Applications and Awards

According to the program solicitation, IRFP fellowships fund research projects with international collaborations that are expected to benefit the applicant, the research discipline, and scientists and engineers in each country. NSF's program data reveal that IRFP is a fairly selective program, having accepted approximately one-third of applications. As shown in Exhibit 3.1, the program has steadily become more competitive, despite year-to-year fluctuations. From 1992 to 2009, NSF program data indicate that the program has received a total of 1,660 applications, with annual applications ranging from 35 (in 1992) to well over 100 (after 2000). The acceptance rate ranges from 63 percent (in 1992) to 21 percent (2004 and 2005), and across the program's history, averages 35 percent.

Exhibit 3.1: Number of IRFP Applications and Percent Awarded, 1992-2009

Year	N Received	Percent Awarded
1992	35	62.9
1993	44	52.3
1994	40	60.0
1995	115	27.8
1996	76	35.5
1997	84	31.0
1998	54	38.9
1999	73	42.5
2000	70	37.1
2001	119	37.8
2002	122	33.6
2003	122	28.7
2004	167	21.0
2005	156	20.5
2006	177	20.9
2007	159	24.5
2008	129	24.8
2009	121	44.6

NOTES: Each application received is counted, such that some individuals who applied for IRFP more than once are included in multiple years; an individual may receive only one IRFP award.
SOURCE: NSF Extant Data, SDR 2008.

3.3 Characteristics and Background of Applicants

3.3.1 IRFP Applicants: Selected Characteristics

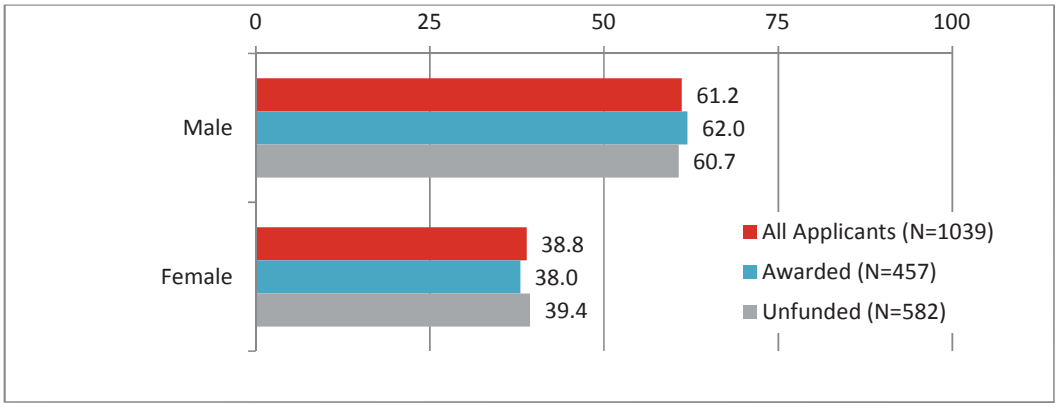
Individuals who apply for IRFP represent a diverse and qualified pool of scientists. In this section, we describe the background characteristics of these applicants.

Demographics

Exhibit 3.2 and 3.3 present the gender and race/ethnicity of applicants, both overall and among those who received fellowships and those who were unfunded. The majority of applicants were male (61 percent), and a majority were either White non-Hispanic (86 percent) or Asian (5 percent).

Seven percent were members of racial or ethnic groups traditionally underrepresented in STEM: 2 percent Black/African-American, 5 percent White-Hispanic, and less than 1 percent each were American Indian or Alaska native or Native Hawaiian/other Pacific Islander. At the time of the survey, 2 percent of individuals who had applied to IRFP reported a disability (0.4 percent of IRFP awarded applicants; 2 percent of unfunded applicants; data missing for 14 applicants, 7 of whom were former awardees).[47]

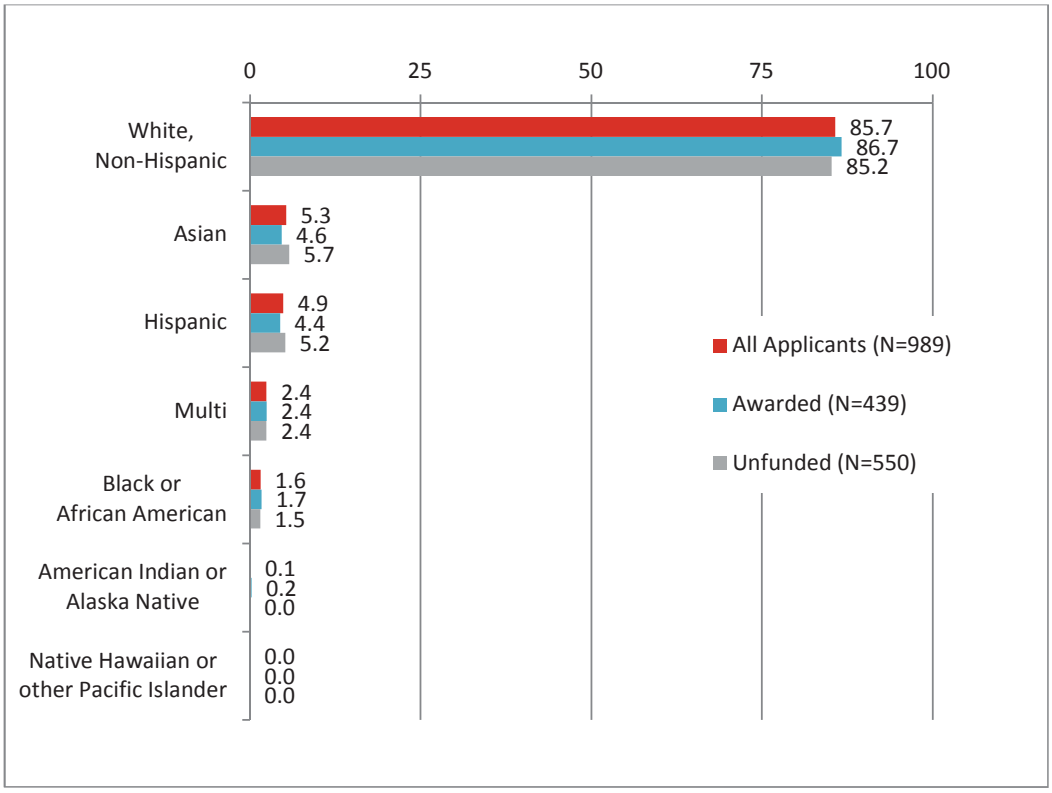
Exhibit 3.2: Gender of IRFP Applicants



SOURCE: IRFP Applicant Survey–Item G1, NSF Extant Data.

[47] Respondents who indicated that they were unable to see (with glasses or contact lenses if usually worn), hear (with hearing aid if usually worn), walk without human or mechanical assistance, or lift 10 pounds, or who reported moderate or severe difficulty with these abilities were classified as disabled. No respondent indicate that they were unable to see, hear, walk or lift.

Exhibit 3.3: Race/Ethnicity of IRFP Applicants



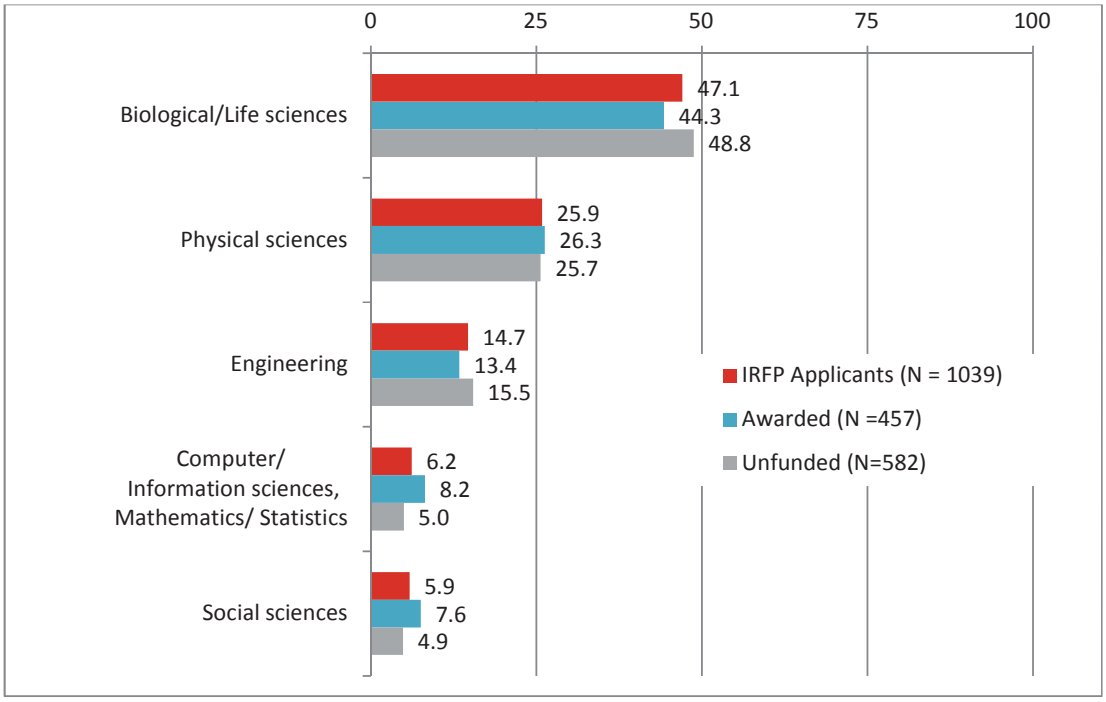
NOTES: Individuals who identified as Hispanic are grouped together regardless of their racial identification. All racial categories exclude individuals who identified as Hispanic. Missing Data: 18 Awarded, 32 Unfunded Applicants.
SOURCE: IRFP Applicant Survey–Item G2, NSF Extant Data.

Field of Research

The disciplinary backgrounds of applicants spanned the range of STEM disciplines represented by NSF directorates (Exhibit 3.4). The largest proportion of applicants had training in life science disciplines (including biological, agricultural and environmental life sciences) (47 percent), followed by physical sciences (26 percent). Fewer applicants were conducting research in engineering (15 percent), and the remaining 12 percent of applicants were conducting research in computer sciences and mathematics (6 percent), and social sciences (6 percent).[48]

[48] This study used the same classification for field of research employed by the Scientists and Engineers Statistical Data System (SESTAT).

Exhibit 3.4: Field of Research at Time of IRFP Application



SOURCE: IRFP Applicant Survey–Item A5, NSF Extant Data.

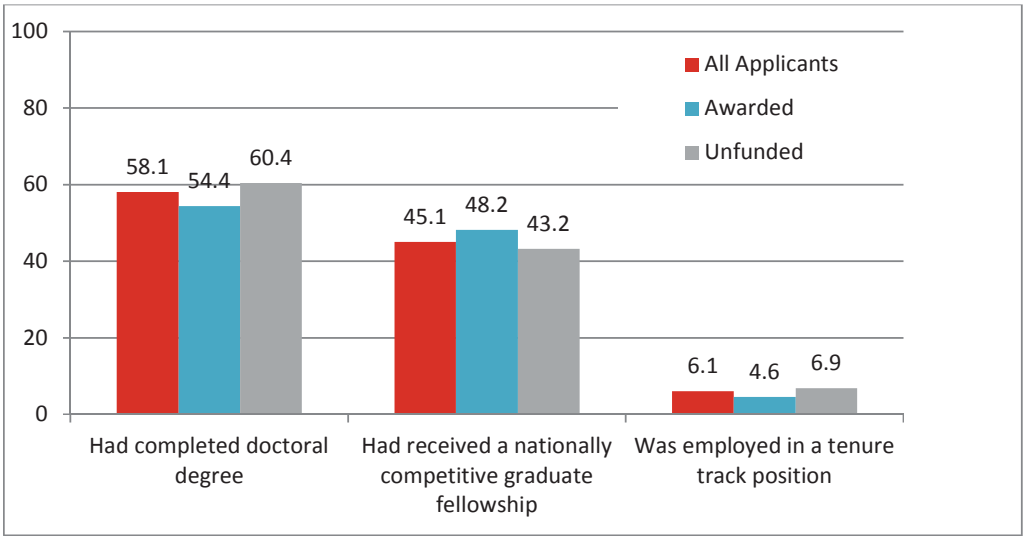
Applicants' Qualifications and Credentials

The IRFP program targets early career recent doctoral recipients. Although applicants were not required to have received their PhD at the time of application, completion of a PhD was required prior to program participation; the maximum post-PhD time allowed varied by solicitation and ranged from two to six years. At the time of their application, 58 percent of IRFP applicants had earned their PhD and 6 percent were employed in a tenure-track position. Among applicants who subsequently received an IRFP award (i.e., IRFP fellows), a smaller proportion (54 percent) had completed their PhD at the time of application compared to applicants who were not funded (60 percent).

On average, awarded and unfunded IRFP applicants shared similar academic credentials at the time of application. Forty-five percent had received a nationally competitive fellowship[49] to support their graduate studies (Exhibit 3.5).

[49] Competitive funding included graduate funding awarded on a competitive basis directly to an individual for use at any graduate institution. Funding from a grant that was awarded to an institution or faculty member was not included.

Exhibit 3.5: Credentials of IRFP Applicants at the Time of IRFP Application



NOTES: IRFP applicants who had not yet officially received their PhD could apply to the program if they expected to receive their PhD by the start of their awarded fellowship. Completed doctorate: N=1035 (456 Awarded, 579 Unfunded Applicants), Missing=4 (1 Awarded, 3 Unfunded Applicants); Graduate fellowship: N=1026 (454 Awarded, 572 Unfunded Applicants), Missing=13 (3 Awarded, 10 Unfunded Applicants); Tenure Track: N=1037 (457 Awarded, 580 Unfunded Applicants), Missing=2 Unfunded Applicants.
SOURCE: IRFP Applicant Survey–Items C2a; C8; C1.

On average, applicants reported having had an average of 9.5 publications at the time of their application (Exhibit 3.6). Relatively few applicants reported that they held patents (a mean of 0.1 patents across all applicants). Few of these publications (16 percent) and patents (less than 1 percent) were with foreign collaborators, although slightly more of the patents of applicants awarded an IRFP fellowship than unfunded applicants were with a foreign collaborator (0.8 percent versus 0.1 percent). Although the percentage of publications with foreign collaborators was low, survey responses provided evidence that applicants had some international experiences and some had already started to explore international research networking prior to application.

Exhibit 3.6: Average Number of Publications and Patents, and Percent Co-authored With Foreign Collaborator at Time of IRFP Application

Publications and Patents	All Applicants	Awarded	Unfunded
Mean number at time of application	**N**	**N**	**N**
Publications	9.5	9.7	9.3
Patents	0.1	0.2	0.0
Of the publication and patents, percent produced with a foreign collaborator	**%**	**%**	**%**
Mean percent of publications	16.0	16.5	15.6
Mean percent of patents	0.4	0.8	0.1

NOTES: Publications included peer-reviewed journal articles, peer-reviewed conference publications and book chapters; patents included registered or pending. Missing Data: 11 to 18 Awarded Applicants; 28 to 35 Unfunded Applicants.
SOURCE: IRFP Applicant Survey–Item C7.

Applicants' Prior International Experience

For some applicants, the IRFP extends previous international experiences, including academic and professional experiences (Exhibit 3.7). For example, 47 percent of IRFP applicants had participated in an undergraduate or graduate study abroad program or had pursued a graduate degree outside the U.S. Further, 44 percent had lived outside the U.S. for six months or more.

There was also evidence that applicants were beginning to explore or build professional relationships or seek networking opportunities with scientists in foreign locations. At the time they applied, 60 percent of IRFP applicants had attended or presented their own research at a professional conference outside the U.S. Further, more than half (53 percent) had collaborated on research with someone from another country, and nearly one-third (33 percent) had published research with someone based in another country. These types of previous international experiences may have sparked some applicants' interest in a postdoctoral fellowship abroad.

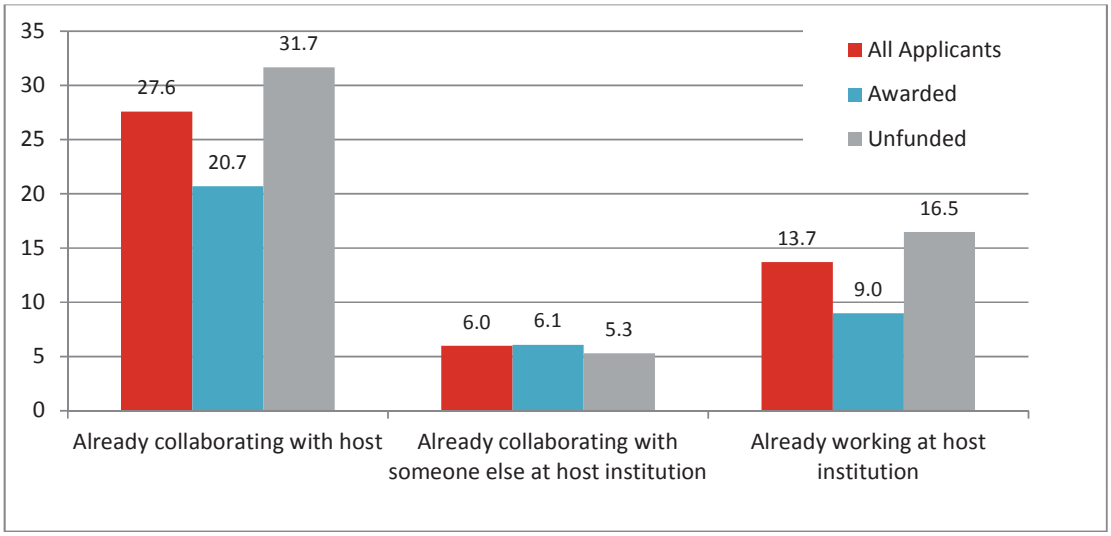
Exhibit 3.7: International Experiences Prior to IRFP Application

Pre-Application International Experience(s)	All Applicants	Awarded	Unfunded
Undergraduate or graduate education abroad[a]	46.5%	47.4%	45.9%
Lived outside the U.S. for ≥ 6 months[b]	43.8	45.8	42.6
Attended elementary or secondary school in another country[b]	14.3	13.9	14.5
Attended or presented scholarly work at a research conference in another country[b]	60.3	61.1	59.8
Collaborated on research with someone based in another country[b]	53.1	55.6	51.6
Published research with someone based in another country[b]	32.8	34.1	32.0
Participated on research team with a scientist visiting from foreign institution[b]	36.0	35.2	36.4
Worked with former IRFP fellow[b]	3.1	3.4	3.0

[a] Includes undergraduate study abroad (C3a), graduate study abroad (C3b) and pursued a graduate degree abroad (C2b). Missing Data: 0 to 3 Awarded Applicants; 4 to 7 Unfunded Applicants.
[b] Missing Data: 2 Awarded, 2 Unfunded Applicants
SOURCE: IRFP Applicant Survey–Items C2b, C3a-3b, C4.

Although a sizeable percentage of IRFP applicants had some prior international experiences in general, fewer IRFP applicants had a preexisting relationship with the particular host scientist with whom they proposed to collaborate (Exhibit 3.8). Overall, 28 percent of applicants were already collaborating with their proposed host scientist at the time of application (and another 6 percent were collaborating with someone at the same institution as their proposed host). However, less awarded than unfunded applicants reported such a preexisting collaboration with their host (21 percent of awarded versus 32 percent of unfunded applicants). Similarly, while 14 percent of applicants overall were already working at their proposed host's institution, this was less often the case for those awarded IRFP fellowships (9 percent) than applicants who were not funded (17 percent). These data appear to reflect a program emphasis on sparking *new* international collaborations rather than reinforcing existing collaborations.

Exhibit 3.8: IRFP Applicants' Pre-application Relationship with Host Scientist or Host's Institution



NOTES: Already collaborating with host, or with someone else at host institution: N=1,033 (455 Awarded, 578 Unfunded Applicants), Missing=6(2 Awarded, 4 Unfunded Applicants); Already working at host institution: N=1,034 (456 Awarded, 578 Unfunded Applicants), Missing=5 (1 Awarded, 4 Unfunded Applicants).
SOURCE: IRFP Applicant Survey–Items C5a-5b.

3.3.2 Hosts' Prior Experience with the U.S.

The scientists and engineers who hosted IRFP fellows were more likely to be familiar with science and engineering in the United States. Although 66 percent of IRFP host scientists had never hosted a postdoctoral fellow from the U.S. prior to hosting an IRFP-sponsored fellow (no exhibit), the majority of IRFP host scientists and engineers had studied, taught, or conducted research in the U.S. before hosting an IRFP fellow (Exhibit 3.9). Just over half had been a visiting scientist in the U.S. Less than 3 percent of IRFP hosts had never visited the U.S. in a professional capacity prior to hosting an IRFP fellow.

Exhibit 3.9: Host Scientists' Experiences in the U.S. Prior to Hosting an IRFP Fellow

Hosts' Pre-IRFP Experiences in the U.S.	Percent of IRFP Hosts (N=328)
Attended a conference, workshop or meeting in the U.S.	75.0
Was a visiting scientist in the U.S.	50.6
Was a postdoctoral fellow in the U.S.	35.1
Was a graduate student in the United States	24.4
Was a faculty member in the U.S.	18.3
Was an undergraduate student in the U.S.	7.6
Other visit to the U.S. for educational, research or professional purposes	7.3
Had not visited the U.S. for professional purposes before hosting an IRFP fellow	2.4

NOTE: Responses do not sum to 100 percent because multiple choices were permitted. Missing Data: 0 Hosts.
SOURCE: IRFP Host Survey–Item B5.

3.4 Preferences, Support, and Motivation

Applicants were asked to describe the support they received from their U.S. advisors, as well as to report the reasons for having applied to IRFP and having selected a particular host location. Foreign hosts were also asked to describe their motivations for participating in the IRFP program. Findings from these responses provide valuable insight into the motivations of individuals, although it is important to note that the data also reflect respondents' retrospective memories about attitudes and beliefs that may reflect distortions of time, particularly when the outcomes of events are known.[50]

3.4.1 Faculty Advisors' Support for IRFP Applicants

According to applicants' survey responses, graduate advisors were supportive of their decisions to apply for IRFP, and many were active participants in the application process (Exhibit 3.10). The majority of applicants' graduate advisors supported (51 percent) or actively encouraged (21 percent) their students' decision to apply for an IRFP postdoctoral fellowship. Further, 49 percent of applicants received feedback from their advisor on their IRFP proposal, and 24 percent received a recommendation from their advisor to a colleague at the host institution.

Exhibit 3.10: Advisor's Support for Decision to Apply for IRFP

	All Applicants (N=1,037)	Awarded (N=457)	Unfunded (N=576)
Support from faculty advisor[a]			
Advisor supported decision to apply	51.2%	51.6%	51.0%
Advisor encouraged me to apply to the IRFP program	21.0	22.0	20.4
Don't know how my advisor viewed my decision to apply	13.7	11.6	15.0
Advisor was indifferent to my decision to apply	6.1	7.6	5.1
I did not have an advisor when I most recently applied	6.0	6.2	5.8
My advisor opposed my decision to apply	2.0	1.0	2.7
Mentoring or guidance from faculty advisor[b]			
Provided feedback on my project proposal	48.6%	54.2%	45.1%
None	38.2	32.3	41.7
Recommended me to a colleague at the host institution	24.2	24.3	24.2
Suggested a host institution	15.3	14.5	15.8
Other	5.2	6.0	4.8
Discussed cultural, language aspects of the host country with me	4.9	6.6	3.9

NOTE: Results do not sum to 100 percent because multiple choices were permitted.
[a] N=1033 (457 Awarded, 576 Unfunded Applicants), Missing=6 Unfunded Applicants.
[b] N=1032 (456 Awarded, 576 Unfunded Applicants), Missing=7 (1 Awarded, 6 Unfunded Applicants).
SOURCE: IRFP Applicant Survey–Items B4 and B5.

Applicants' Proposed Host Countries

In addition to drawing candidates with a strong interest in and potential for successful international collaboration, applicants' preferences for host sites reflected a broad geographic distribution,

[50] Hawkins, S. A., & Hastie, R. 1990. Hindsight: Biased judgments of past events after the outcomes are known. *Psychological Bulletin,* 107(3), 311–327; Stahlberg, D., & Maass, A. 1998. Hindsight bias: Impaired memory or biased reconstruction? *European Review of Social Psychology,* 8, 105–132.

although the applicant pool showed preference for regions with more developed research infrastructures (Exhibit 3.11). Most commonly, host institutions proposed by applicants were in Europe (60 percent), followed North America (10 percent), and the South Pacific (9 percent), which included Australia, New Zealand, Papua New Guinea, Fiji Islands, Palau, and the Solomon Islands.

Applicants who proposed to work with a host in South or Central America had the highest success rate (47 percent of applicants to this region were funded), followed by Europe (41 percent); a smaller proportions of applications to other North American countries (i.e., Canada or Mexico: 31 percent) and Africa or the Middle East (31 percent) were funded.

Exhibit 3.11: Geographic Region of Proposed Host Site Country and Success Rate of Applications

	% of Applicants to Region	% Successful within Region
Europe	60.2	40.8
North America	10.4	30.9
South Pacific	9.4	38.3
South and Central America	9.4	47.1
Africa/Middle East	7.2	31.2
East Asia	5.0	36.2

SOURCE: IRFP Applicant Survey–Item A3; NSF Extant data

3.4.2 Applicants' Motivations

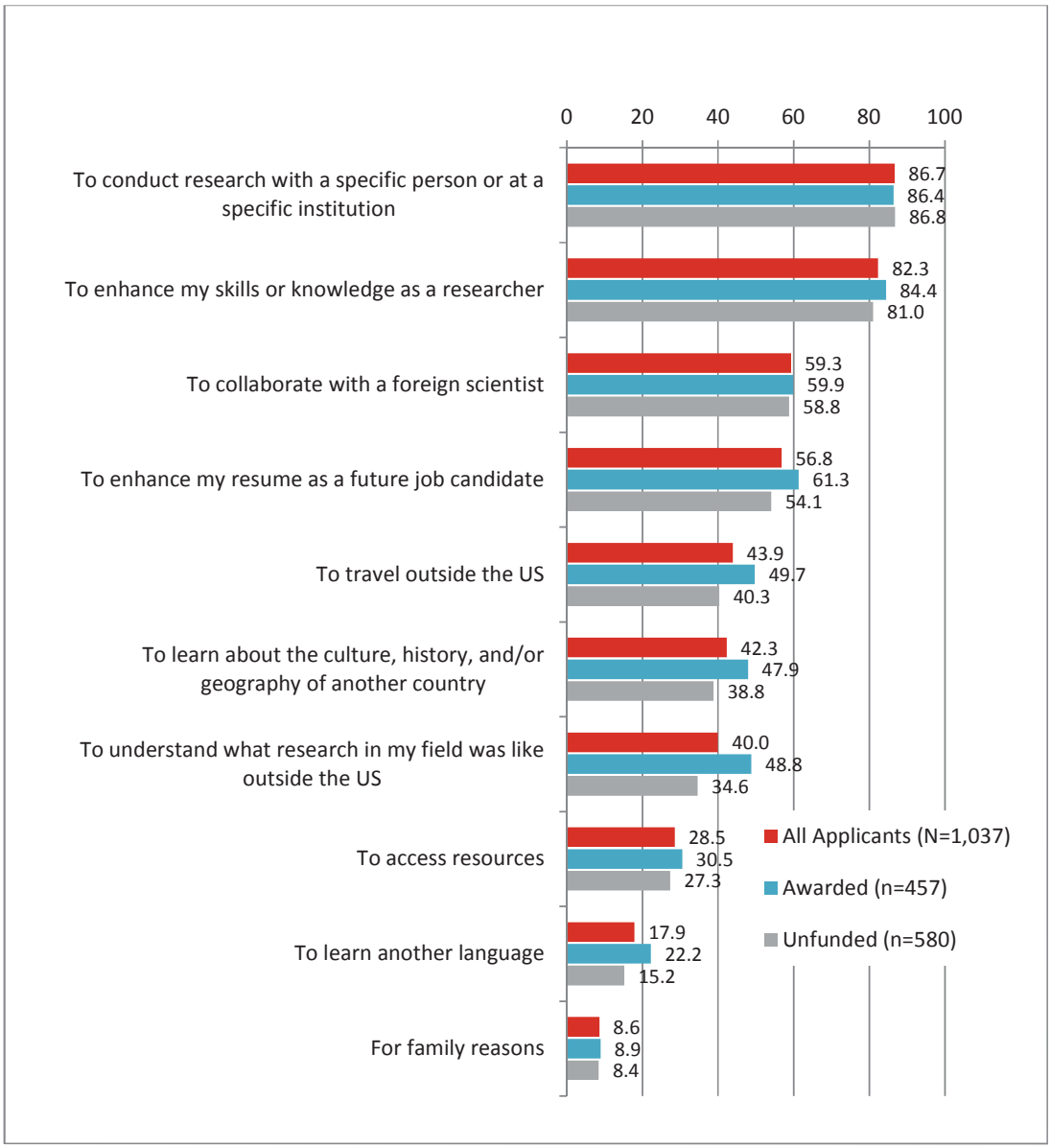
IRFP applicants generally cited multiple reasons for applying to IRFP (Exhibit 3.12), and some reasons were commonly mentioned. More than four-fifths cited a desire to work with a specific person or at a specific institution and to enhance their research knowledge and skills (87 and 82 percent, respectively). About three-fifths indicated that they wanted to collaborate with foreign scientists generally (59 percent), and a majority believed that an IRFP award would enhance their resumes (57 percent). Just under half also expressed the appeal of traveling outside the U.S. (44 percent), the desire to learn about another country (42 percent), and understanding what their research field was like outside the U.S. (40 percent). Less than one-third noted that they were motivated by a desire to access a particular resource (29 percent). A greater proportion of awarded than unfunded applicants cited a desire to learn about how research in their field was conducted outside of the U.S. (49 versus 35 percent, respectively) and to gain access to resources that were unavailable in the U.S. (31 versus 27 percent).

> *[The IRFP Fellowship] allowed me to [do] research that was possible only by working in collaboration with the host institution and conducting fieldwork in the host country. I chose this country specifically because regional biogeography allowed me to follow the path of inquiry that I had hoped to examine.* (IRFP Applicant)

Applicants' reported motivations for applying may not have been particularly relevant to their award outcome, although it is possible that some of their motivations were, at least implicitly, conveyed in their proposals. Slightly more awarded than unfunded applicants thought that an IRFP award would enhance their resumes (61 versus 54 percent). Awardees were also more likely than

unfunded applicants to report cultural motivations for applying (e.g., desire to learn about the culture, history, geography or language of another country).

Exhibit 3.12: Applicants Reasons for Applying to IRFP



NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 2 Unfunded Applicants.

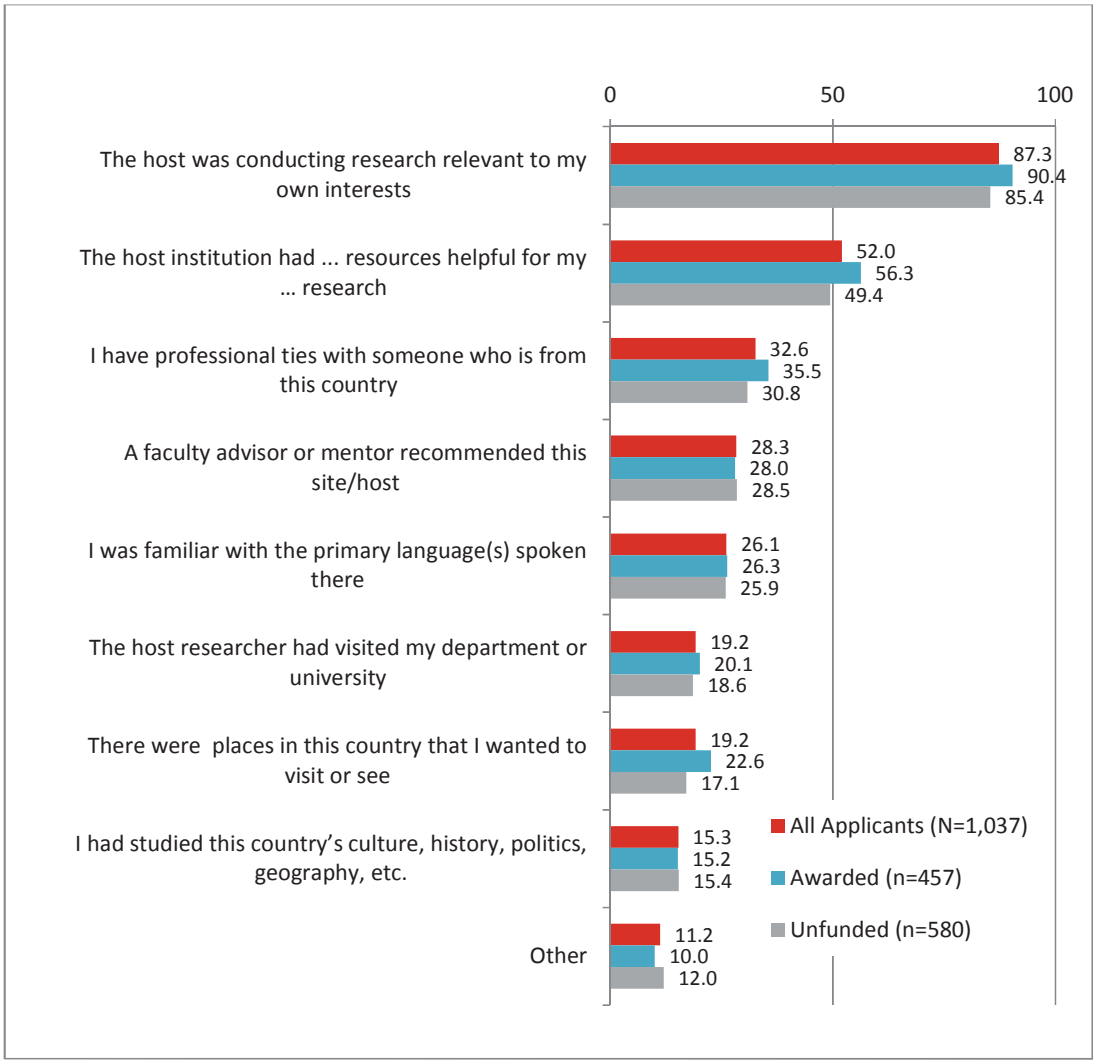
SOURCE: IRFP Applicant Survey–Item B1.

Applicants also cited multiple motives for proposing a particular host country (Exhibit 3.12); a large majority reported that they wanted to work with a particular host located in that country (87 percent), and over half noted that the host's institution had equipment or resources that would benefit their research (52 percent). Less than 50 percent of applicants cited any other single reason for selecting a particular host site.

> *… the chance to work with ... scientists [in my host country] during the 1990s, an exciting period of change when the involvement of [scientists in my host country] in field ecology and conservation was just at its initial stages.* (IRFP Applicant)

Awarded fellows may have benefited from closer alignment between their own research and their respective proposed hosts' interests and resources: a higher percentage of IRFP awardees than unfunded applicants indicated that the host's research was relevant to their own (90 versus 85 percent), and that the host's institution had resources beneficial to their research (56 versus 49 percent). In addition, more IRFP awardees than unfunded applicants explained that they selected their proposed site because they had professional ties with someone in that country, and more awarded fellows cited a desire to visit particular places in the host country.

Exhibit 3.13: Applicants Reasons for Selecting a Specific Host Country



NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 2 Unfunded Applicants.
SOURCE: IRFP Applicant Survey–Item B2.

3.4.3 Hosts: Motivations and Concerns

Foreign scientists with whom IRFP fellows worked cited a variety of motives for hosting an IRFP fellow, most frequently having interest in the research project that the fellow had proposed (83 percent of host researchers) (Exhibit 3.14). Another common motive, cited by 60 percent of hosts, was a desire to create an international environment in their research group; 44 percent cited a general interest in establishing a collaboration with someone in the U.S. The host's prior knowledge of the fellow or the fellow's advisor also played a role for more than 40 percent of hosts.

Exhibit 3.14: Hosts' Motivations for Hosting the IRFP Fellow

	Percent of Hosts (N=328)
I was interested in the project proposed by the fellow	82.9
To create an international environment in my research group	59.5
To attract students/postdocs to my research	48.8
I personally knew, knew of, or previously collaborated with the fellow	47.0
I was interested in establishing or maintaining collaboration with a U.S. researcher	43.9
I personally knew, knew of, or previously collaborated with fellow's doctoral advisor	43.3
To learn new methodologies, approaches, or tools from the fellow	35.4
I had a positive experience with other U.S. postdoctoral or visiting researchers (not IRFP-funded)	30.5
I personally knew, knew of, or previously collaborated with researchers at fellow's institution	20.7
I had a positive experience with the IRFP program in the past	4.6

NOTES:. Responses do not sum to 100 percent because multiple choices were permitted. Missing Data: 0 Hosts
SOURCE: IRFP Host Survey–Item B2.

The majority of hosts reported no specific concerns about collaborating with an IRFP fellow (77 percent). The percentage of hosts who indicated one or more concerns was less than 10 percent (Exhibit 3.15).

Exhibit 3.15: Hosts' Concerns about Hosting the IRFP Fellow

	Percent of Hosts (N=328)
I was concerned about the integrating this postdoctoral fellow into my research group	6.4
I was concerned about the fellow's level of commitment to a collaboration with me	5.2
Other concerns not listed	3.7
The fellow's proposed project was especially risky	3.7
I was concerned that I might not (or my research group might not) benefit from hosting this fellow	3.0
In my field, individuals trained at U.S. graduate institutions sometimes have gaps in their knowledge, skills, or abilities	2.4
I was concerned about the risks of international collaboration in general	1.8
I had a negative experience with the IRFP program in the past	0.3
No concerns indicated	77.2

Missing Data: 0 Hosts.
SOURCE: IRFP Host Survey–Item B3.

4 Fellowship Experience

This chapter describes the IFRP fellowship experience from the perspectives of both the IRFP fellows and the research scientists who hosted them. Findings include reflections on the fellows' engagement in research and cultural activities, fellows' and hosts' perception of aspects of their research collaboration, fellows' and hosts' satisfaction with various aspects of their IRFP experience, and perceived challenges of the fellowship.

Specifically, this chapter addresses the following question:

- What are the program experiences of program participants?

> *[IRFP] is an experience which is culturally enriching, and scientifically productive. Research at the forefront of science requires combining the best researchers and facilities on the world. It is often necessary to combine equipment and expertise by people on different continents, if one really wants to get the best possible results.* (IRFP Host)

Findings in this chapter are drawn from 457 IRFP fellows who completed the applicant survey and 328 foreign researchers who responded to the IRFP host survey. As explained in the methodology section, percentages for fellows are weighted to adjust for nonresponse, while reported n's are not weighted. Differences between fellows by geographical location of their fellowship are described where statistically significant.

4.1 Key Findings

- Former fellows and hosts offer strong endorsement for the IRFP program. All former IRFP fellows would recommend the program to a colleague, and the large majority of hosts (84 percent) would recommend, or have already recommended, to others that they host an IRFP postdoctoral fellow from the U.S.
- Hosts and fellows agreed they worked collaboratively on developing project ideas and hypotheses, interpreting results, and planning follow-up work.
- Hosts and fellows agreed that fellows worked mostly independently collecting data, carrying out simulation, and keeping records or tracking supplies and resource.
- Over 90 percent of fellows were somewhat or very satisfied with the quality of research they were able to conduct as part of IRFP (92 percent) and the timing of the fellowship with respect to their career goals (97 percent).
- Other professional activities featured prominently in the experiences of many fellows. Specifically, IRFP provided fellows with the opportunity to network with colleagues from institutions outside their host institution (90 percent), attend lectures in their field (89 percent), visit other institutions (89 percent), attend conferences (84 percent), and give talks at their institution (71 percent).

- Fellows also experienced a variety of cultural activities including sightseeing (96 percent) outdoor activities that explore geography (95 percent), museums (89 percent), and festivals or holidays (85 percent).
- Forty percent of fellows reported no noteworthy difficulties during their fellowship. The most common challenges were related to logistics (32 percent) and language difficulties (20 percent), followed by inadequate access to space or resources (16 percent), and not enough guidance from the host researcher or research group (15 percent).
- Over 80 percent of fellows were satisfied with many aspects of their host, including the match between research interests, the host's expertise and contributions to the research, their inclusion in collaborations, and frequency of meetings.
- Most hosts (75 percent) reported no difficulty in hosting an IRFP fellow. Specific challenges were identified by less than 10 percent of hosts, including noting that the fellow did not devote enough time to the research collaboration (10 percent), and the fellow worked too independently or did not work well as a collaborator (8 percent).
- Hosts noted that IRFP fellows compared favorably to other postdoctoral fellows with whom hosts had worked; 56 percent of hosts were much or somewhat more satisfied with IRFP fellows compared to other postdoctoral fellows, and another 28 percent were equally satisfied.
- Only one-third of hosts reported any challenges experienced in hosting an IRFP fellow.
- Hosts generally strongly agreed or agreed (72 and 24 percent, respectively) that their IRFP fellow had sufficient knowledge and expertise, and that the fellow integrated well with their research group (66 and 26 percent, respectively).

4.2 Program Recommendation

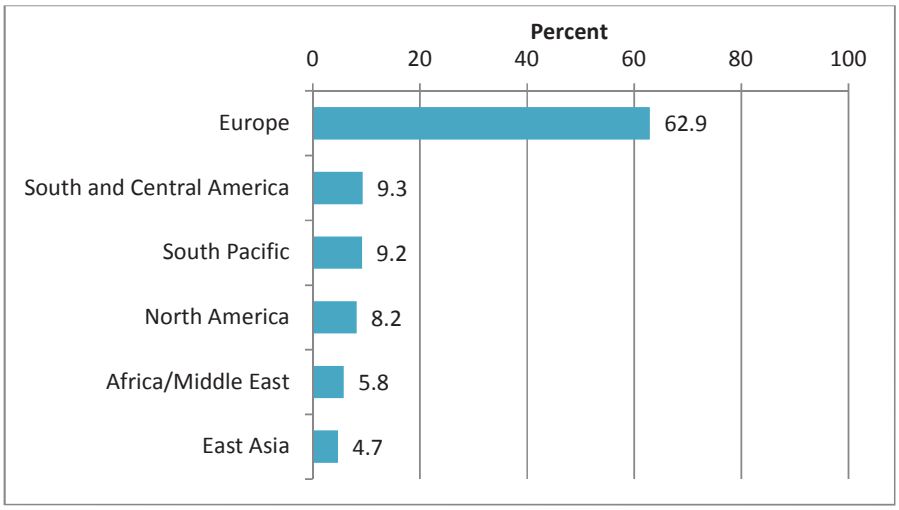
Former fellows and hosts offered strong endorsement for the IRFP program. One hundred percent of former IRFP fellows would recommend the program to a colleague; 97 percent would recommend their host country; and 79 percent would recommend their host scientist to a colleague. Among hosts to IRFP fellows, 84 percent would recommend, or have already recommended, to others that they host an IRFP postdoctoral fellow from the U.S.; another 14 percent indicated that they might recommend hosting an IRFP fellow depending on the qualifications of the individual candidate.

4.3 Geographic Locations

Between 1992 and 2009, the majority of IRFP fellows spent their postdoctoral appointments in Europe (63 percent, Exhibit 4.1). Fewer conducted research in South or Central America (9 percent), the South Pacific (e.g., Australia, New Zealand, Palau, Papua New Guinea, or the Solomon Islands; 9 percent), Canada or Mexico (8 percent), Africa or the Middle East (6 percent), and East Asia (China,

India, Indonesia, Malaysia, Mongolia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka or Taiwan; 5 percent).[51]

Exhibit 4.1: Regional Location of IRFP Fellows' Host Institutions, 1992–2009



SOURCE: IRFP Applicant Survey–Item A3.

4.3.1 Language Preparation

In preparation for their internationally based postdocs, 42 percent of fellows completed some form of language study (Exhibit 4.2), including self-guided study (28 percent), formal courses (18 percent), and tutoring (7 percent). Many fellows (44 percent, no exhibit) indicated that they were already familiar with the language spoken in the host country.

Although 21 percent of fellows indicated that they experienced communication or language difficulties during their fellowship (see "Barriers Encountered" below), only a fraction of host scientists reported that language differences posed a challenge: 7 percent agreed or strongly agreed that language differences were a barrier to their fellow's ability to interact with their research group, and just 1 percent reported that their IRFP fellow's lack of familiarity with their language made collaboration more difficult than they had expected.

Exhibit 4.2: Language Study in Preparation for IRFP Fellowship

	Percent of IRFP Fellows (N=450)
No language study	**58.2**
Any language study	**42.3**
Yes, some self-guided language study	28.4
Yes, formal language training course	17.6
Yes, study with tutor or conversation partner	6.8

NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 7 Fellows.
SOURCE: IRFP Applicant Survey–Item E1.

[51] The locations in Exhibit 3.11 were the host location applicants proposed, while the locations in Exhibit 4.1 represent the actual host locations of awardees.

4.4 Fellows' Experience

4.4.1 Fellow-Host Collaboration

As described in Chapter 3, for most fellows the primary reason to pursue an IRFP fellowship was to conduct research with a particular host scientist or at a particular institution. Of particular interest, then, is the fellows' experience collaborating on various aspects of their research with their host. Nearly three-fourths (73 percent) of fellows indicated that the host researcher provided direct supervision and 22 percent indicated that they were not supervised by anyone (Exhibit 4.3).

Exhibit 4.3: Individual(s) Who Provided Direct Supervision to IRFP Fellows During Fellowship

	Percent of Fellows (N=448)
The host researcher him/herself	73.1
No one: I was not supervised by anyone	21.8
Another staff scientist	13.3
A junior faculty member or postdoctoral fellow	7.7
A laboratory technician or other employee/worker	4.9
Another graduate student(s)	3.3

NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 9 Fellows.
SOURCE: IRFP Applicant Survey–Item E6.

Variation in the host supervisor's role may well reflect the fellow's level of expertise or desire for independence, the nature of the research, and the size of the research team involved, among other factors. As one fellow commented,

> *My host functioned as an advisor. He was present whenever I needed advice. Otherwise, I functioned rather autonomously. I consulted with my host as well as other individuals … mostly to avoid cultural conflicts as well as to benefit from their respective knowledge*. (IRFP fellow)

Comments provided by fellows illustrate the value of their hosts in their IRFP experiences:

> *My weekly meetings with my host supervisor were consistently inspiring and extremely productive in pursuing my research. They will have a lasting impact on how I do my research.* (IRFP fellow)

> *My best scientific work has been done with [my former host] and most of what I know about how to be a good scientist I learned from him. He continues to be a valued mentor to me.* (IRFP fellow)

> *The IRFP fellowship gave me the opportunity to work with one of the most well-respected researchers in my field on a one-to-one basis. I have become a better scientist and gained a valuable mentor and friend through this experience.* (IRFP fellow)

Additional descriptive understanding of fellows' interactions with their hosts emerges from an examination of fellows' and hosts' perceptions of their contributions across a range of research activities and tasks (Exhibit 4.4).

The majority of fellows reported that they worked independently of their host for many activities. Interestingly, the majority of hosts were in disagreement with the majority of fellows. The hosts

reported that they and their fellow contributed about equally to the same activities. This apparent discrepancy between fellows' and hosts' perceptions likely results, in part, from two common cognitive biases affecting autobiographical memory. In a range of group settings, individuals inflate their own contribution to a joint task in achieving a goal relative to other members of the group.[52] In addition, individuals' perceptions of their behaviors tend to be biased in such a way that they see themselves acting in accordance with an internal schematic encompassing their motives and goals.[53] Thus, it is likely that fellows perceived their contributions as favoring their developmental goal of establishing themselves as independent researchers, whereas hosts were likely to perceive their contributions as favoring their motivation to be an effective mentor, nurturing the fellow's professional development through extensive collaboration.

Nevertheless, looking across fellows' and hosts' perceived contributions across several activities, a picture emerges of which activities were characterized as most and least collaborative by both fellows and hosts. For example, fellows and hosts generally agreed that certain research activities were more collaborative than other activities, including developing project ideas and hypotheses, interpreting results, and planning follow-up work (Exhibit 4.4, top and bottom panels). The majority of both fellows and hosts credited fellows with working mostly independently to collect data or carry out simulations (66 percent of fellows and 58 percent of hosts) and to keep records or track supplies and resources (64 percent of fellows and 57 percent of hosts). In addition, for all but one activity (developing instrumentation, software, equipment or other data collection processes) less than 10 percent of fellows or hosts reported that the host was primarily involved without input from the fellow.

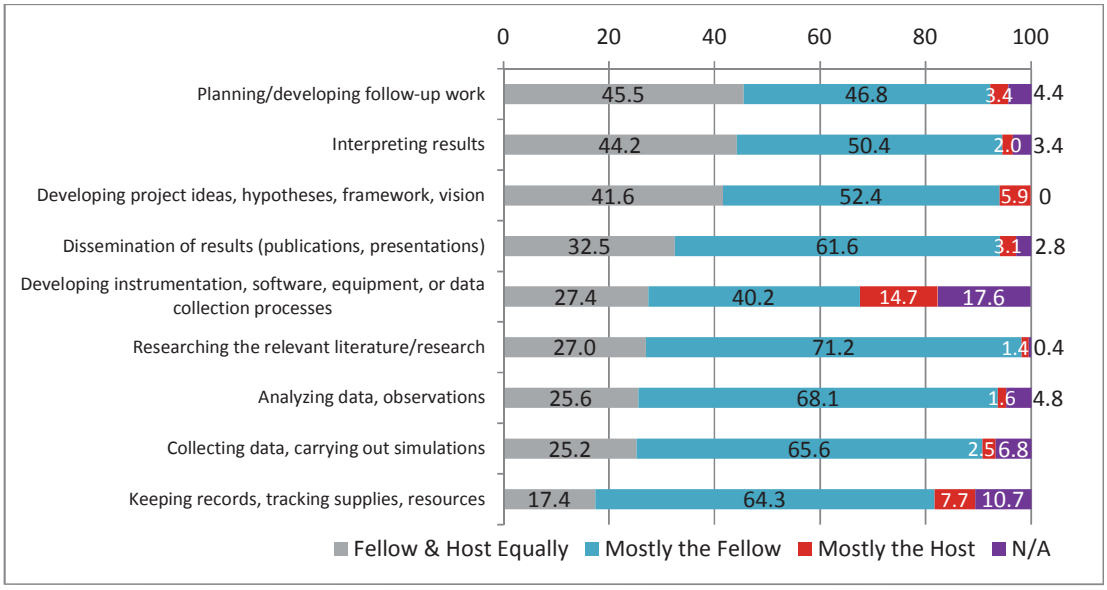
There was less agreement between fellows and hosts about the degree of collaboration in researching relevant literature and analyzing data. Whereas 47 percent of hosts believed that they and the fellow were equally involved in researching extant literature related to their project, only 27 percent of fellows reported equal collaboration in this activity. Similarly, 43 percent of hosts reported that they and their fellow were equal contributors to data analyses, but less than 26 percent of fellows perceived equal engagement in this activity. Again, differences between fellows and hosts may well reflect individuals' (whether the fellow's or the host's) tendency to overestimate their own role in a collaborative effort.

[52] Kruger, J., & Savitsky, K. 2009. On the genesis of inflated (and deflated) judgments of responsibility: Egocentrism revisited. *Organizational Behavior and Human Decision Processes*, 108 (1), 143-152; Ross, M. & Sicoly. F. 1979. Egocentric biases in availability and attribution. Journal of Personality and Social Psychology, 37, 322-336.

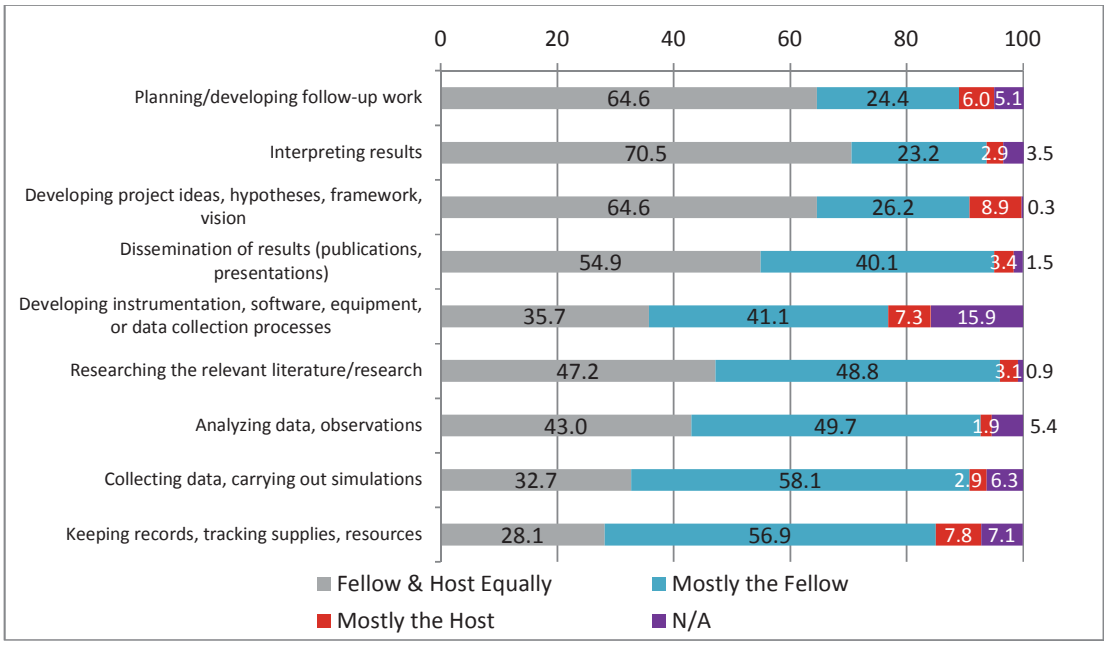
[53] Woike, B. 2008. A functional framework for the influence of implicit and explicit motives on autobiographical memory. *Personality and Social Psychology Review,* 12(2), 99-117Conway, M.A. & Pleydell-Pearce, C.W. 2000. The construction of autobiographical memory in the self-memory system. Psychological Review, 107(2), 261-288.

Exhibit 4.4: Fellows' and Hosts' Perception of Who was Primarily Involved in Activities Related to the IRFP Research Project

Fellows' Perception



Hosts' Perception



IRFP Fellows: N=457, Missing: 9 to 14 Fellows. IRFP Hosts: N=328, Missing: 3 to 14 Hosts.
SOURCE: IRFP applicant survey–Item E4; IRFP host survey–Item C1.

4.4.2 Professional and Cultural Activities

In addition to pursuing their primary research with their host, fellows engaged in many other professional activities (Exhibit 4.5), including networking with colleagues from institutions other than their host's (90 percent), attending lectures, seminars, and colloquia in their field (89 percent), attending professional conferences in their host country (84 percent), giving an oral presentation to researchers at their host institution (71 percent), and visiting businesses or industrial sites relevant to their research interests (23 percent).

> *One of my most memorable activities was a trip [to another city in Europe] to attend a workshop…. It was very soon after my arrival to my host laboratory. At the workshop I was able to meet and learn from experts in my field from all over Europe [and] I was honored to give a talk describing my doctoral research. This is something I never would have done if I had not been working in Europe.* (IRFP fellow)

Exhibit 4.5: Professional Activities of IRFP Fellows During Fellowship

Professional Activities	Percent of Fellows (N=450)
Networking with colleagues from institutions other than host	90.3
Lectures, colloquia, seminars in my field	89.4
Visit(s) to educational or research institutions other than host	88.5
Attended professional conferences in host country	84.0
Gave talk or presentation to researchers in host site	71.1
Visit(s) to businesses/industrial laboratories	22.5
Other	3.6

NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 7 Awarded Applicants.
SOURCE: IRFP applicant survey–Item E3.

> *Living outside the United States was both technically and cultural [sic] rewarding. Although I went to become a better scientist, being introduced to another language, a different way of life and new traditions was far more enriching.* (IRFP fellow)

Activities abroad also included cultural activities, which many fellows reported to be rewarding (Exhibit 4.6). Over one-third of fellows (34 percent) attended language courses or engaged in some other type of language study during their fellowship. The most frequently cited leisure activities included sightseeing (96 percent), outdoor activities (95 percent), visiting museums (89 percent) and attending festivals, holiday events or religious ceremonies (85 percent).

Exhibit 4.6 Cultural Activities during Fellowship

Cultural and Leisure Activities	Percent
Sightseeing	96.3
Outdoor activities to explore the landscape/geography	95.4
Museums	89.1
Festivals/Holidays/Religious ceremonies	85.1
Non-scientific lectures or presentations	57.3
Sporting events	48.3
Language courses or language study[a]	34.3
Other	7.6
No participation in cultural activities	0.6

[a] This question asked about language study during fellowship, while Exhibit 4.2 included language study in preparation for fellowship.
SOURCE: IRFP applicant survey–Item E3.

4.4.3 Barriers Encountered

Forty percent of IRFP fellows reported that they had encountered no difficulties during their fellowship (Exhibit 4.7). Responses from those who cited barriers, however, noted logistical challenges (32 percent), such as transportation or navigating through foreign bureaucracies, and communication or language difficulties (20 percent). Sixteen percent reported inadequate access to space, facilities, computers, or other resources, and 15 percent noted that they did not receive enough guidance from their host (or their host's research group). Less than 6 percent cited other difficulties related to their collaboration (e.g., insufficient credit for their contributions, being assigned a role less than merited by their skills or knowledge), or based on gender, disability status, or racial or ethnic, cultural, or religious backgrounds.

Exhibit 4.7: Difficulties Experienced During the Fellowship

	Percent
None	39.7
Logistical difficulties (e.g. transportation, navigating bureaucracy, etc.)	31.5
Communication or language difficulties	20.2
Inadequate access to space, facilities, equipment, computers, resources, supplies	16.0
Not enough guidance from host/host's research group	14.5
Not given credit for my contributions to advancing a project	5.9
Encountered barriers or discomfort based on my gender	5.2
Legal or medical difficulties in my host site	4.9
I felt that my ideas were not treated with respect	4.6
I was asked to do work that was someone else's responsibility	3.7
Encountered barriers or discomfort based on my cultural or religious background	3.5
My role on the project was less than merited my skills/knowledge	2.9
Encountered barriers or discomfort based on my race/ethnicity	1.5
Encountered barriers or discomfort based on a disability	0.4
Other difficulties	9.7

NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 8 Fellows.
SOURCE: IRFP Applicant Survey–Item E5.

Although fellows infrequently reported difficulties, the difficulties encountered varied considerably by region, thus responses are broken out by region in Exhibit 4.8. A greater percentage of fellows in East Asian locations experienced difficulties than fellows in other regions. The proportion of fellows who reported experiencing no difficulties ranged from 5 to 60 percent, with fellows placed in East Asian locations less likely than fellows placed in other regions to report no difficulties. The most frequent challenge fellows in East Asia reported were logistical difficulties (55 percent of such fellows). Such difficulties were also frequent among fellows residing in South or Central America (50 percent) and Africa or the Middle East (46 percent). Fellows in East Asia were also more likely than other fellows to cite communication or language difficulties (45 percent) and inadequate access to space, facilities, equipment or resources (40 percent). In contrast, less than one-quarter of fellows experienced communication difficulties in Europe (24 percent), Africa and the Middle East (21 percent), South and Central America (16 percent) or North America (12 percent). However, lack of access to facilities or resources posed a difficulty for non-trivial proportion of fellows in South and Central America (32 percent) and those in Africa and the Middle East (22 percent). Less than 15 percent of fellows in Europe, the South Pacific, or North America encountered this problem. Finally, about twice the proportion of fellows in East Asia relative to fellows in other regions reported that

they had not received enough guidance from their host: 31 percent of fellows in East Asia cited this difficulty compared to 17 percent in North America, 15 percent in Africa and the Middle East, and 15 percent in Europe.

Thirteen percent of fellows in East Asian locations felt that their ideas were not greeted with respect. Notably, 10 percent of fellows in the South Pacific and North America each encountered barriers or discomfort based on their gender; such gender-based difficulties were also reported by 9 percent of the fellows in East Asia and by those in Africa and the Middle East.

Exhibit 4.8: Difficulties Experienced During Fellowship, by Region of Host Institution

Percent of Fellows Encountering Difficulties by Region	East Asia (N=22)	Europe (N=263)	South & Central America (N=46)	Africa & Middle East (N=29)	North America (N=42)	South Pacific (N=47)
Logistical difficulties (e.g. transportation, navigating bureaucracy, etc.)*	55.4	28.4	49.9	46.2	25.8	16.7
Communication or language difficulties*	45.1	23.7	15.5	20.8	11.8	0.0
Inadequate access to space/facilities/equipment/computers/resources/supplies*	40.3	13.0	32.3	22.2	12.1	6.2
Not enough guidance from host/host's research group	30.6	14.8	10.7	15.4	17.2	6.2
Other	17.7	11.0	4.0	6.4	11.5	4.2
I felt that my ideas were not treated with respect	12.8	4.3	4.3	5.4	7.0	0.0
Legal or medical difficulties in my host site	8.6	4.8	4.3	5.4	2.2	6.2
Encountered barriers or discomfort based on my gender	8.6	2.8	6.6	8.6	9.6	10.2
Not given credit for my contributions to advancing a project	4.3	6.4	4.0	9.0	7.0	2.0
Encountered barriers or discomfort based on my race/ethnicity	4.3	1.7	0.0	0.0	2.5	0.0
Encountered barriers or discomfort based on a disability	4.3	0.3	0.0	0.0	0.0	0.0
My role on the project was less than merited my skills/knowledge	0.0	2.9	2.3	5.4	4.8	2.0
I was asked to do work that was someone else's responsibility	0.0	4.6	0.0	5.4	7.0	0.0
Encountered barriers or discomfort based on my cultural or religious background	0.0	4.3	2.0	5.4	2.2	2.3
None*	4.9	39.1	35.7	34.4	47.5	60.1

*Regional differences were statistically significant at p <.05.

EXHIBIT READS: 55.4 percent of fellows in an East Asian host location experienced logistical difficulties during their fellowship.

NOTES: Results do not sum to 100 percent because multiple choices were permitted. Missing Data: 1 to 5 Fellows.

SOURCE: IRFP applicant survey–Item E5.

4.4.4 Challenges Cited by IRFP Hosts

The most interesting finding related to hosts' difficulties is that the majority reported that they did not experience difficulty. Of those who reported any challenges in hosting an IRFP fellow (Exhibit 4.9), the two most frequently cited difficulties encountered were the fellow not devoting enough time or effort to the research collaboration (10 percent) and concern that the fellow worked too independently and did not collaborate well with others (8 percent).

Exhibit 4.9: Hosts' Reported Difficulties Hosting an IRFP Fellow

	Percent of Hosts (N=326)
The fellow did not devote enough time/effort to the research collaboration	9.8
The fellow worked too independently, did not work well as collaborator/team member	8.3
Other difficulties	6.4
The fellow and I had differences of opinion about the direction of research	4.6
The fellow had unanticipated gaps in his/her preparation to conduct research with me	4.6
The fellow lacked sufficient understanding of cultural norms in my country	3.4
The fellow was disrespectful, caused conflict within my research group	3.1
The fellow needed too much guidance	1.8
The fellow's lack of familiarity with the primary language spoken in my research group made collaboration more difficult than anticipated	1.2
None of the difficulties listed	65.3

Missing Data: 2 Hosts.
SOURCE: IRFP Host Survey–Item E3.

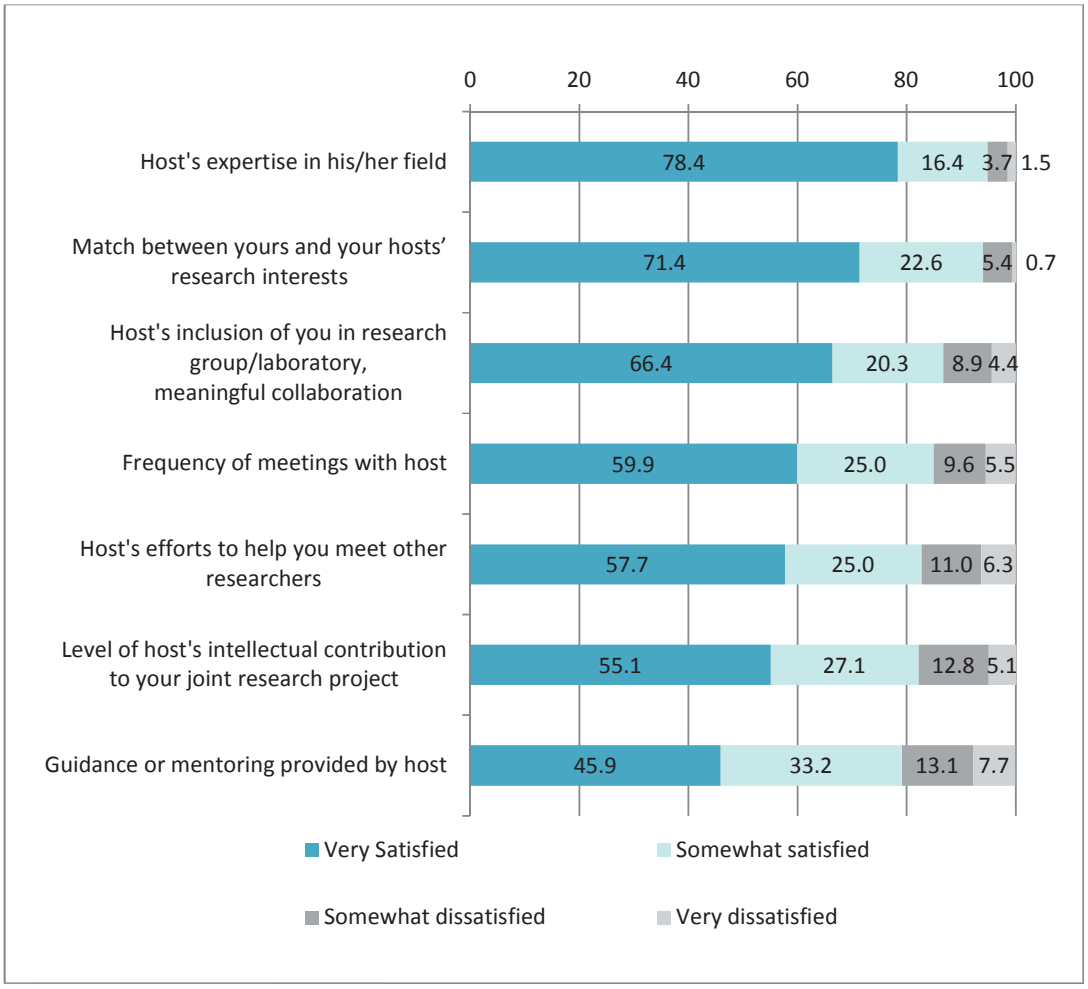
4.4.5 Fellows' Satisfaction with IRFP

Both fellows and hosts were, on the whole, satisfied with their collaboration (Exhibit 4.10). Over 80 percent of fellows were very or somewhat satisfied with the match between their own and their host's research interests, with their host's expertise and contributions to the research, with hosts' inclusion of fellows in meaningful collaboration and efforts to help fellows meet other researchers, and with the frequency of meeting with their host. However, about one-fifth (21 percent) of fellows were somewhat or very dissatisfied with the guidance or mentoring provided by their host. Fellows' open-ended responses provide some insight. Among 359 open-ended comments on areas of satisfaction and/or dissatisfaction with their IRFP experience, about 10 percent expressed difficulty interacting with their host or other colleagues at the host institution. For example:

> *My mentor was close to retiring and was not fully engaged with the day to day workings in the laboratory. The project … that he presented to me when I was applying to IRFP was not really taking place when I arrived. I had to start from scratch without really very much laboratory support.* (IRFP fellow)

> *The host was rarely present and attempted to run the laboratory via telephone or email. Moreover, there was no qualified laboratory scientific management or personnel to help run the lab in his absence.* (IRFP fellow)

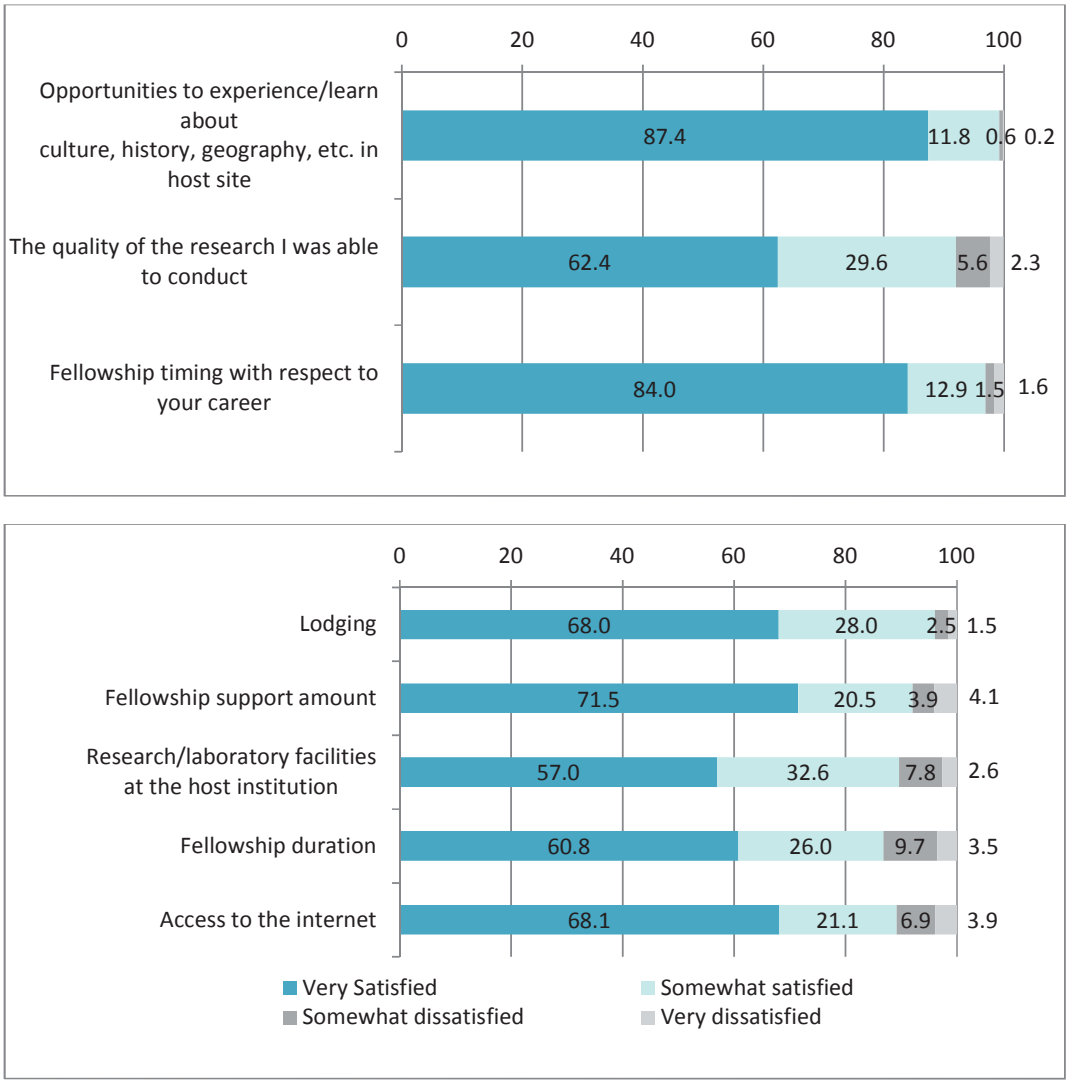
Exhibit 4.10: Fellows' Satisfaction with Host



N=457, Missing Data: 11 to 13 Awarded Applicants; Guidance or Mentoring Provided by Host: 18 Awarded Applicants.
SOURCE: IRFP Applicant Survey–Item E7.

Ninety-two percent of fellows were *somewhat* or *very* satisfied with the quality of research they were able to conduct as part of IRFP. Over 90 percent of fellows were somewhat or very satisfied with several other aspects of their IRFP fellowship (Exhibit 4.11, top and bottom panels), including the opportunities to learn about their host country (99 percent), and the timing of the fellowship with respect to their career goals (97 percent). More than 92 percent were somewhat or very satisfied with the amount of fellowship support. Though few fellows indicated dissatisfaction, the most common areas of dissatisfaction were the duration of the fellowship (13 percent) and the research facilities and access to the internet at their host institution (10 percent and 11 percent, respectively).

Exhibit 4.11: Fellows' Satisfaction with Aspects of IRFP Fellowship

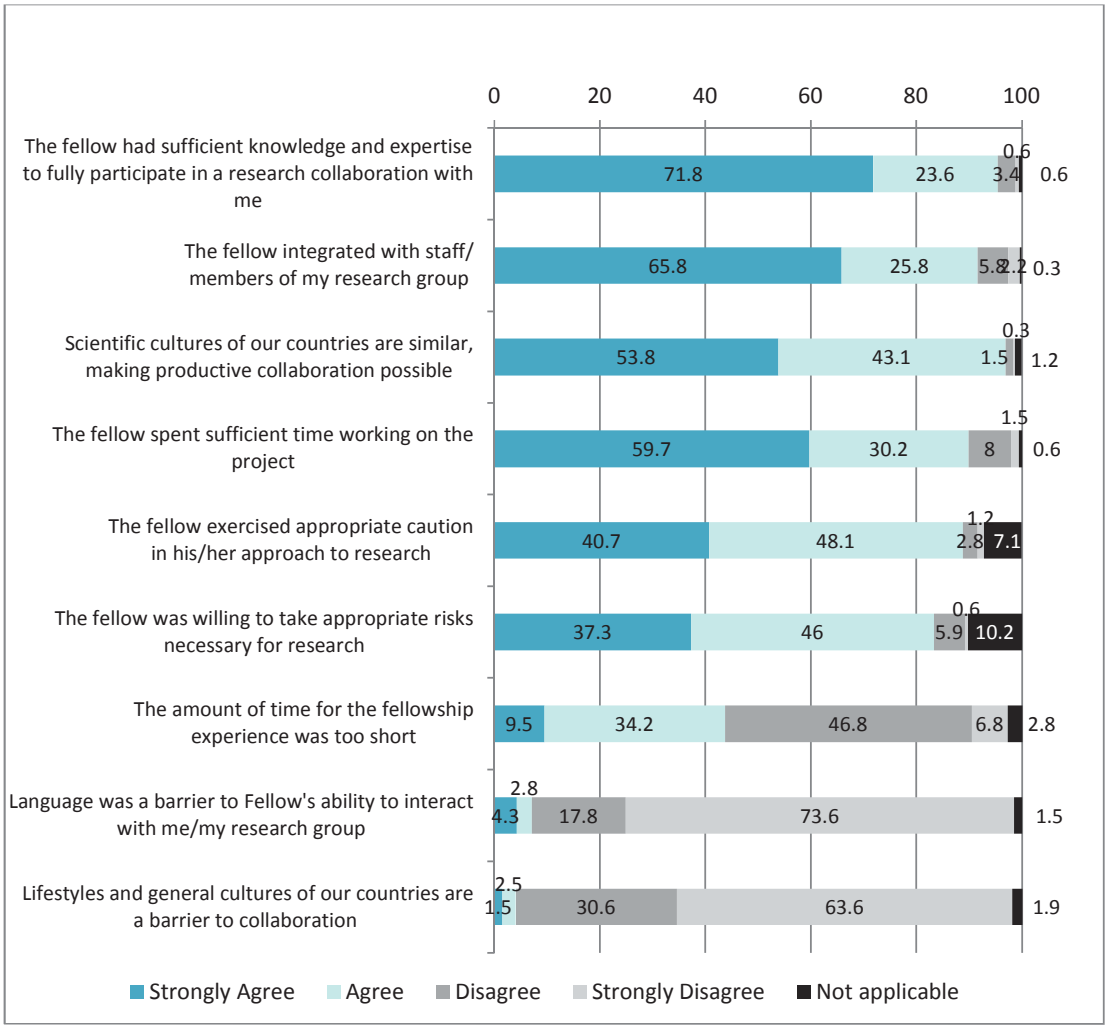


N=457, Missing Data: 9 to 12 Awarded Applicants (top and bottom panels).
SOURCE: IRFP Applicant Survey–Item E7.

4.4.6 Hosts' Satisfaction with IRFP

Similarly, hosts had positive perceptions of their fellows and their experience hosting their IRFP postdoctoral fellow (Exhibit 4.12). Hosts strongly agreed (72 percent) or agreed (24 percent) that their IRFP fellow had sufficient knowledge and expertise, and strongly agreed (66 percent) or agreed (26 percent) that the fellow integrated well with their research group. Most hosts felt that fellows balanced appropriate caution (41 percent strongly agreed and 48 percent agreed) and with appropriate risk-taking (37 percent strongly agreed and 46 percent agreed) in conducting research. The only area of concern for some hosts was the duration of the fellowship: more than 40 percent of hosts agreed or strongly agreed that the duration was too short.

Exhibit 4.12: Hosts' Perception of the Fellow and Their Collaboration



N=328, Missing Data: 2 to 6 Hosts.
SOURCE: IRFP Host Survey–Item C2.

IRFP fellows also compared favorably to other postdoctoral fellows with whom hosts had worked, as 83 percent were at least equally satisfied with their IRFP fellow compared to other postdoctoral fellows (see Exhibit 4.13). About 10 percent were somewhat less satisfied, and 7 percent were much less satisfied with their IRFP fellows. In open-ended comments, hosts specifically cited IRFP fellows' scientific knowledge, high levels of motivation and commitment, and the ease of interacting with the fellow:

> *[The fellow] led a large experimental study still ongoing that represented one of the most ambitious and interesting experiments ever conducted in my lab. This study also brought in other collaborators (students and PIs) and represents one of the most satisfying collaborations of my career.* (IRFP host)

Hosting [the fellow] was a pleasure. He was a highly motivated researcher and very productive. I fell that both he and I (and [the institution]) benefitted from our collaboration. I was not aware that the IRFP program was still ongoing but I will take steps to encourage more U.S. postdoctoral fellows to apply to it. (IRFP host)

The fellow is a hard working and very enthusiastic researcher, well trained at U.S. during her PhD. She integrated very easily our team and will be a future collaborator. (IRFP host)

It was always a pleasure to have this particular fellow around. He was … a sociable and modest person whilst being a creative and industrious researcher. A very charming combination indeed. (IRFP host)

Exhibit 4.13: Hosts' Satisfaction with IRFP Fellow Compared to Other Postdoctoral Fellows

How satisfied were you overall with this IRFP postdoctoral Fellow compared to other postdoctoral fellows?	Percent of Hosts (N=307)
Much more satisfied	28.3
Somewhat more satisfied	27.4
Equally satisfied	27.7
Somewhat less satisfied	9.8
Much less satisfied	6.8

NOTES: Only those hosts who had worked with postdoctoral fellows other than the IRFP fellow were included (N=307, Missing=21)).
SOURCE: IRFP Host Survey–Item E1.

Although the majority of hosts held positive views of the fellow and of the IRFP program as a whole, a handful of host scientists expressed dissatisfaction with the program or with their particular fellow. Of the 279 hosts who commented on what was most satisfying or unsatisfying about the fellow or the IRFP fellowship program (Item E1a), only about 5 percent had expected a greater number of joint publications or a more fruitful subsequent collaboration. Five percent mentioned interpersonal problems with the fellow. One host, for example, noted that "this [IRFP] postdoc did not focus enough on the project we had together, and tried to keep several collaborations elsewhere, travelling abroad regularly." Although rare, a handful of hosts felt that the IRFP program was too short:

We spent most of the year laying foundations and if we had continued for a second year we would have produced many more outputs. (IRFP host)

… the IRFP financing was shorter than the natural duration of the project, and thus the fellow could not stay at my institution until the logical conclusion of the research (which required a year longer than the IRFP financing). (IRFP host)

4.4.7 Fellows and Hosts Would Recommend IRFP to Others

I recommend [IRFP] most highly to every grad students who comes through my office (I have also led informal postdoc workshops where I strongly encourage students to apply). The opportunity to spend an extended amount of time dedicated to research in a different cultural setting …was an incredible experience. I moved on to the job market with renewed energy, new perspectives on my research, and a greater appreciation for international collaboration (and a stronger CV). (IRFP fellow)

Former fellows and hosts overwhelmingly reported that they would recommend (or had already recommended) participation in the IRFP program to others. One hundred percent of fellows endorsed the IRFP program, and nearly 80 percent would recommend their former host scientist (Exhibit 4.14).

Exhibit 4.14: IRFP Fellows' Willingness to Recommend IRFP, Host Country and Host Scientist to others

Would you recommend…	Percent of Fellows
… IRFP to a colleague?	
Yes	100
No	0.0
… your host country to a colleague?	
Yes	97.3
No	2.7
… your host scientist to a colleague?	
Yes	79.4
No	20.6

NOTES: Only IRFP fellows who had completed their fellowship by October 1, 2010 (N=384) received these items on the survey. Missing Data: 8 to 10 Fellows.
SOURCE: IRFP Applicant Survey–Items F9-11.

Former hosts also exhibited strong enthusiasm for the IRFP program. As shown in Exhibit 4.15, 84 percent of hosts would unequivocally recommend hosting an IRFP fellow to others. Another 14 percent said that their recommendation would depend on the qualifications of an individual IRFP candidate. Less than 2 percent indicated any hesitation to recommend the program.

Exhibit 4.15: Hosts' Willingness to Recommend IRFP to Others

Would you recommend (or have you recommended) to others that they host an IRFP postdoctoral fellow from the United States?	Percent of Hosts (N=321)
Yes	84.1
No, I would not recommend to others that they host an IRFP postdoctoral fellow from the U.S.	0.6
I might recommend hosting an IRFP fellow, but it depends on the qualifications of the individual postdoctoral candidate	14.0
I might recommend hosting a postdoctoral fellow from the U.S., but the IRFP program created challenges for me or my postdoctoral fellow	0.9
I am not sure	0.3

Missing Data: 7 Hosts.
Sources: IRFP Host Survey–Item E7.

More than one-third of hosts who would recommend IRFP commented on the high quality of the fellows:

> *These are dedicated scientists with excellent background [sic]. They can work independently, but are willing to collaborate.* (IRFP host)

About one in five hosts cited the cross-cultural benefits of hosting an IRFP postdoc:

> *The whole lab benefited from the experience. We were enriched by new theoretical/analytical perspectives. We were enriched by new ways to deal with data collection, data analysis, lab*

meeting dynamics and research in general. The lab in general was stimulated to search for collaboration with researchers abroad. (IRFP host)

4.5 Descriptions of Experiences

Both fellows and hosts elaborated on their experiences with the program through open-ended responses.

4.5.1 Fellows

Fellows were given an opportunity to elaborate on the most positive aspects of their IRFP experience, and 425 respondents provided a response. The large majority elaborated on professional experiences and benefits, and about 20 percent described a personal experience. Ninety-three people mentioned a personal experience (e.g., the opportunity to be immersed in a new culture, improved language skills, the development of long-lasting friendships, etc.).

I made great friends and made good memories. I was able to become a part of a local community and to really experience things as something other than an outsider. After three months, I was thinking and speaking in the language. I joined a local sports club with which I skied in the winter and kayaked in the summer. This club had a local meeting place / sports facility where we would gather 1–3 evenings per week. I came away from the IRFP experience having been genuinely immersed in the culture. Although I would never be happy settling in that country, I came away with a fondness for the place. (IRFP fellow)

Over one hundred fellows (115) commented that the most positive aspect of the fellowship was its provision of unique opportunities and experiences that they would not have received elsewhere. Some discussed how these experiences paved the way for research opportunities after the IRFP fellowship had ended, while others described new skills that they acquired as a result of their experience.

I was able to pursue research questions that I was extremely interested in and could not have pursued in the U.S. This experience has helped define my research direction for many years to come. (IRFP fellow)

For me, the most positive aspect of my IRFP experience was the chance to work with [country] scientists and conservationists during the 1990s, an exciting period of change when the involvement [country] science in field ecology and conservation was just at its initial stages. Together, my colleagues and I made exciting discoveries and stimulated the interest of others in [country] about biodiversity and the need to protect the natural world. (IRFP fellow)

The most positive aspect of the IRFP experience was acting as a PI. I formulated the research plan, wrote the proposal, was rejected the first year I applied, took the criticisms of the reviewers and re-wrote the proposal, won the second year I applied, went to the host institution, set up the laboratory, conducted research independent, wrote the paper and published. As an overall experience and a mini-version of what I do now as an academic, it was a great experience. (IRFP fellow)

> *It allowed me to follow an interesting direction for my research that was possible only by working in collaboration with the host institution and conducting fieldwork in the host country. I chose this country specifically because regional biogeography allowed me to follow the path of inquiry that I had hoped to examine because the various taxa that I wanted to study come into contact exclusively in this region.* (IRFP fellow)

> *The opportunity to develop and implement a new research program. Working largely independently—but with a very experienced and supportive host readily available—was an ideal stepping stone between graduate school and a faculty position.* (IRFP fellow)

One hundred and nine respondents described how the program allowed them to develop and strengthen their professional networks by introducing them to researchers and colleagues they might not have otherwise been able to meet.

> *… by far the most positive aspect of my IRFP experience was that I met astronomers in [country] that I might not have otherwise gotten to meet, and this has led to multiple collaborations.* (IRFP fellow)

> *It allowed me to collaborate on a scale uncommon to most U.S. labs and has led to most of my success where all of my research is interdisciplinary.* (IRFP fellow)

> *I really met a lot of people who helped me in one way or another that year and later. Knowing the researchers from my host institute helped me to recruit newly graduated students to help with my job. It also connected me with researchers from Australia who have continued to collaborate to this day. (IRFP fellow)*

Fifty-two people elaborated on the positive effect of the IFRP program on their career. Some became more aware of potential career choices and refined their future goals, while others noted that the experience bolstered their CV and made them more competitive for subsequent positions.

> *… it shaped my entire research program from 1998 to now and into the future. It has been the most important event in my career.* (IRFP fellow)

> *It was my first chance to completely direct my own research, since I brought my project idea to the host lab. Also, my gaining more comfort with the country and language—and gaining familiarity with research there—contributed to my accepting a permanent position in that country years later.* (IRFP fellow)

> *The most positive aspect is that I benefited greatly as a scientist. I now have a faculty position (in the U.S.), and I think my IRFP experience played a large role in me winning the opportunity.* (IRFP fellow)

Finally, 30 people felt that a very positive aspect of the program was that it exposed them to different research cultures and new perspectives.

> *I was able to spend a significant amount of time (several years) in a foreign country, which has expanded my understanding of the U.S. In particular, I experienced a very different research environment that I will try to replicate in my own laboratory.* (IRFP fellow)

The fellowship allowed me to understand how research is undertaken at [university], and to interact with the best researchers in my field. It also allowed me to travel to Spain and work in several Spanish Universities, where the research and academic structure are much different than that in the U.S. These contrasts among countries, in research and teaching approaches, were what I most appreciated about my fellowship. (IRFP fellow)

4.5.2 Hosts

Hosts elaborated on what they perceived to be the best aspects of their affiliation with IRFP. There were 261 responses to this question. Hosts cited specifics of the fellows, the research, and the products resulting from the collaborations.

Half of the hosts (133) commented that some of the best aspects were the outcomes that resulted from these collaborations. Specifically, 108 of the hosts noted how they or their lab experienced some type of advancement in their research (e.g., new lines of research opened up, they became aware of new research questions, interests, or techniques, etc.) as a result of IRFP.

The IRFP fellow came to work in a subject [discipline]) in which none of my group had worked before, even though we had developed tools that could be applied in this field. He therefore gave us the possibility of doing work in a new field, which is not strongly developed in [location]. (IRFP host)

The fellow made significant advances that greatly improved our understanding of our research topic. He was full of good ideas and several led to fruitful projects and excellent publications. (IRFP host)

Collaboration was great and we have identified a very interesting area of collaboration. Interaction with the fellow in small meetings and in lab meetings was great. She has now a very strong and interesting database with which we will start publishing and will develop new collaborations. It was interesting to see the different approaches to many logistic aspects of research and to learn from these differences. The Postdoctoral fellow stimulated my students to think in different directions, to try different statistical analyses. She helped them with their English writing. (IRFP host)

His knowledge and ideas enhanced the intellectual atmosphere of our research group. He obtained very good data and they yielded interesting conclusions and led to further work. My continued contacts with him (discussions of questions of mutual interest) have been valuable. (IRFP host)

[The fellow] contributed to the intellectual life in my laboratory by interacting with my graduate students, demonstrating laboratory techniques to them, and providing a broader perspective on the research field. The work we did was successful although it still has not reached the publication stage. (IRFP host)

There was an excellent confluence between the group's direction and the background of the fellow, which resulted in a scientifically productive project which benefited all. (IRFP host)

> *[The fellow] was very productive as a researcher and as a result a number of papers got published that probably would not have been achieved without her substantial input. She was also easy to work with, and very highly motivated.* (IRFP host)

Ninety-one hosts noted that the best aspect was the resulting collaboration that occurred, either with the fellow, the fellow's U.S. institution, or other international institutions.

> *[The fellow] is indeed an independent thinker willing to take risky approaches. He often challenged my ideas which often resulted in very productive discussions.* (IRFP host)

> *This collaboration was extremely fruitful, and still continues. We have projects, and 1 student, in common.* (IRFP host)

> *The increased cooperation with the fellow's home institution and his colleagues/former advisors and the special research expertise he brought to the particular project at hand.* (IRFP host)

> *That I established a long-term collaborative link with a U.S. researcher, who was able to establish himself as a new faculty member in Ohio, making it possible to build a long-term link between our labs.* (IRFP host)

Forty-one hosts reported that the best aspect of the program was having the opportunity to work with a fellow who displayed impressive academic knowledge and skills, and 33 hosts were impressed with the fellow's interpersonal skills, and their ability to successfully integrate into the lab.

> *The best aspects was that [the fellow] brought valuable complementary competence in molecular analyses (and sexual selection) to our lab, and helped train students in my lab and also beyond (he organized a highly rated PhD course in such methods for students from all Nordic countries, after having successfully applied for funding of the course to the Nordic Marine Academy).* (IRFP host)

> *[The fellow] was … a very stimulating scientist, eager to collaborate, and open for scientific discussions. He operated at the frontiers of fundamental research in my group and was a pleasant and very cooperative colleague. His ambition is a tenure-track position at a U.S. university, which he has acquired and which I fully support.* (IRFP host)

> *The fellow, besides being a good scientist, also had excellent social skills, and he played an important role in improving the relations between people in our group and the overall atmosphere in our group.* (IRFP host)

> *As noted previously, this was the start of a long term collaboration extending well beyond the original project. The individual is a talented academic, a great experimentalist, open to new ideas and a real pleasure to work with.* (IRFP host).

> *[The fellow] was a good citizen who helped others with their own research problems, as well as improving the social life of the group* (IRFP host).

He worked extremely hard and used his complete time frame for performing research. This included seven days a week including holidays. Additional he made nice social effort to approach my family. And he did not complain about the restrictions to work scientifically in the culture of [location]. (IRFP host)

Excellent scientific discussions. He was always very helpful, with a good academic formation and, in general it was very pleasant to discuss data analysis and science in general. (IRFP host)

He was a considerable stimulus to our research and interests, and I believe that he similarly benefited from his time here. He was one of about 6 postdoctoral researchers in my group at that time, and he contributed fully to the group and was a great asset. (IRFP host)

Although we have not collaborated closely in the last few years, I and members of my group have kept in touch with [the fellow]. We have involved her in Special Sessions at conferences. While she was in the lab, she was very active in group discussions and in encouraging other researchers. (IRFP host)

Eleven hosts reported that the best aspect was the financial support they received from IRFP. Five noted that the best aspect was participating in the fellow's professional growth process.

It [the program] allowed a U.S. fellow to join my laboratory and provided some research and travel money for the fellow, which many fellowship programs do not. This is an ideal system to foster collaborations with U.S. scientists. (IRFP host)

My postdoc came to my lab to learn about investigating the mechanical properties of biomaterials, and it was really a pleasure to see him grow in skill, knowledge and enthusiasm in his research. (IRFP host)

Thirty-one responses described other aspects (e.g., co-supervised and trained younger students, became personal friends, etc.), and 15 hosts indicated that there was either no best aspect of the program, or they provided information on a negative experience.

4.6 Recommendations from Former Fellows and Hosts

[*IRFP] is a very valuable program in the NSF portfolio, helping to develop U.S. researchers and foster new multi-national collaboration. In difficult economic circumstances it is easy to look for savings in areas such as this, …but I would say that in helping to develop more rounded young scientists this program returns a great deal in benefits to the intellectual capital of the U.S. for a relatively modest outlay.* (IRFP host)

Responses to open-ended request for recommendations for the program from fellows and hosts provide some insight into areas that might benefit from improvements. First, although 279 fellows provided a response to this question, 77 respondents commented that they would not change anything about the program, leaving only 202 who made an actual recommendation. The recommendations for the program made by fellows and hosts align with addressing some of the challenges that were reported previously in this chapter.

4.6.1 NSF's Timing and Flexibility in Award Administration Is Appreciated

As presented in Chapter 3, the majority of applicants received notification from NSF in sufficient time to make arrangements (87 percent). Those who received an IRFP award were more likely to find the timing of notification appropriate (94 percent) than were unfunded applicants (82 percent). Several former fellows appreciated the flexibility NSF provided when the timing of their IRFP award conflicted with other opportunities or events. For example:

> *I was awarded the IRFP at about the same time I received my first tenure track faculty position offer. The fact that the program allowed me to modify my plans so that I could accept the faculty position and still conduct the research proposed in the IRFP (by using the IRFP to … travel to the foreign country over several summers) was very important to me. I would not have developed an international research program if the IRFP had not allowed this flexibility.* (IRFP fellow)

> *I had a baby just prior to being notified that I had received the fellowship, and I really appreciated the opportunity to extend the research funds portion of the grant without penalty so that I can work part-time while my [child] is still young without compromising my ability to complete the research project.* (IRFP fellow)

However, one former fellow noted that the timing of award notification was "a little off." The fellow reported,

> *I graduated in May, and didn't get the fellowship until the beginning of the next year. It was difficult to figure out if I was going to have funding to do the post-doc abroad. It would be nice if there was a way to apply twice a year.* (IRFP fellow)

4.6.2 The Duration of the IRFP Fellowship Should Be Lengthened

Of the 202 fellows who suggested changes to the IRFP program, 60 recommended increasing the length of the fellowship; this recommendation came from fellows who had been awarded one- or two-year fellowships.

> *Principally, because of the length of the fellowship, most of what I did was move. Just when I was getting settled in figuring out my host institution and making progress on the project, I had to leave to start all over again for the domestic component. And then during the domestic component I had to divide my time between the first part of the project, the second part of the project and finding a job because the fellowship was ending. A three year grant would ameliorate some of these difficulties.* (IRFP fellow)

Some host scientists also shared this view. One host was particularly dismayed by the short duration:

> *It lasted one year only, which is not sufficient for the type of project involved. We would have been far more productive if she had been here for 2 years. Returning to the U.S. just scuppered what we were doing and caused her to have to start other projects. A real shame for everyone involved. Flexibility was absent.* (IRFP host)

4.6.3 IRFP Fellows Would Benefit from Advice Regarding Financial and Logistical Challenges

Almost 12 percent of those fellows who described their most challenging experience during the IRFP fellowship mentioned unexpected financial difficulties due to fluctuating currency exchange rates.

> *The IRFP salary allowance does not allow for adjustments in exchange rate. My salary was fixed … when the exchange rate between the U.S. and [the currency of my host country] was favorable. In six months the exchange rate flip-flopped and my working salary was reduced by 30%. This created a very difficult economic scenario with regards [sic] to rent and food and basic living expenses. Having to ration created a stressful experience.* (IRFP fellow)

> *The biggest challenge I faced was in handling the accounting and finances of this grant. The transition from being a graduate student, and receiving relatively small research support with an accounting structure in place within the doctoral university, to suddenly receiving a multi-year grant with the money coming directly to the fellow was overwhelming. I am happy with the flexibility that came with this fellowship, … but I think NSF should provide more help with at minimum questions about foreign income and tax status.* (IRFP fellow)

> *The most challenging aspect [of IRFP] was dealing with the bureaucracy that comes with working in a foreign country, such as setting up a bank account, driving license, visa, and bank transfers from the U.S. (the fellowship money is paid in U.S. currency to a U.S. account and the exchange rate changed dramatically during the course of my fellowship, not in my favor.* (IRFP fellow)

> *I also found it very frustrating to pay for things using a U.S. bank account. I had not taken into account the cost of transferring funds to [my host country] in my budget.* (IRFP fellow)

Recommendations to address the financial issues included providing information to fellows about how the fellowship funding is distributed and cautioning potential fellows about the possible consequences of unfavorable exchange rates; allowing applicants to propose a higher budget if the cost of living in a proposed host location is exceptionally high; and setting up a support network, perhaps comprised of former fellows, to provide information on the financial, logistical burdens of working and living abroad:

> *When I was [a fellow], there was no network to support any of us—we were scattered all over the world, and there weren't any forums to ask questions about how to deal with issues like health insurance, immigration visas, etc. specific to a given country.* (IRFP fellow)

A handful of former fellows recommended that an alumni gathering of former IRFP fellows could also provide a forum for newly awarded fellows (or even IRFP applicants) to exchange helpful information:

> *The IRFP program would benefit from more active internal (IRFP) networking activities (for example, alumni gatherings or even a mini-workshop bringing current and past fellows in contact).* (IRFP fellow)

4.6.4 Advance Language Preparation Would be Beneficial

Both former fellows and hosts suggested that IRFP fellows would benefit from better language preparation in advance, even in countries where most citizens speak English:

> *Learning a new language is very difficult. Luckily, the scientists all spoke English, but it was sometimes frustrating to not be able to participate fully in conversations.* (IRFP fellow)

> *Try to learn a bit of [the language]. It encourages … people to make an effort and speak English with you (They also usually like to help you speak [the host country's language] better…. It is important for the social life.* (IRFP host).

In countries where English is not widely spoken, the importance of advance preparation may be more critical. As one fellow noted,

> *I studied [the host country's language] part-time when I first arrived, but struggled with the language as most foreigners do. By the end of my time in [my host country] I became very frustrated by my mediocre ability, which I felt prevented me from assimilating better.* (Former IRFP fellow

In particular, the language difficulties experienced by a substantial proportion of fellows in East Asian locations suggest that those intending to pursue an international collaboration in this region might benefit from more intensive language preparation.

4.6.5 Fellows Should Discuss in Advance the Availability of Institutional Resources and the Host's Support

Addressing the lack of adequate access to facilities or resources poses a more difficult challenge, since there is less likelihood that a postdoctoral fellow can prepare for this in advance. Fellows might be advised to discuss with their host in detail the facilities, equipment, and other resources to which they will and will not have access during their fellowship, what resources the host institution has to maintain, repair or replace equipment that may break during the fellowship, and what arrangements fellows may need to make in advance of their visit (e.g., submitting paperwork to arrange identification allowing access to research facilities, or secure time on shared equipment).

A handful of fellows indicated that their intended hosts were largely absent from the laboratory or research facility during their stay; two mentioned that the host departed from the host institution before or shortly after the fellow arrived, despite having agreed to collaborate with the fellow.

About one in ten hosts who offered recommendations for U.S. scientists considering an international postdoctoral fellowship recommended some advance preparation to become familiar with the host institution and potential host scientist. One such host emphasized:

> *It is very important to prepare the ground by establishing contact beforehand, find out what the most interesting research interests might be, given the local expertise, available data and resources. In our case we did this partly by preparatory workshops (supported by a grant from NSF) and also by invitations to other conferences or workshops (that we hosted).* (IRFP Host)

4.6.6 Benefits of IRFP Collaborations

Several former fellows and hosts mentioned the importance of cross-cultural exchange to their professional and personal development. For example, many former fellows cited the benefits of international collaboration for broadening their research skills. As one former fellow put it, "scientists in different countries have very different ways of approaching a problem. Through IRFP my technical and philosophical toolbox has been increased a lot." Another indicated that she "learned new research and analytic skills—techniques that, at the time of my fellowship, were not widely being used in the USA."

Other fellows credited their international collaboration with having a transformative effect on their professional development:

> *My first field trip with researchers in my field that were from my IRFP host institution [was one of the most memorable events]. It was immediately apparent that the methods and techniques I learned at my U.S. graduate institution were not the only way of doing things! This really taught me to think critically about how to best conduct research and the value of thinking laterally about problems/questions and how this can yield very interesting results. That exposure to a different "worldview" has been invaluable and continues to serve me very well indeed. (IRFP fellow)*

> *IRFP was the most enlightening professional experience I have ever had. Getting the opportunity to work with researchers outside the U.S. has opened up a whole new world of ideas and ways of doing things, and has made me a much more confident, effective, and innovative researcher.* (IRFP fellow)

Many hosts also indicated that they had benefitted from the cross-cultural exchange:

> *The IRFP fellow came to work in a subject … in which none of my group had worked before, even though we had developed tools that could be applied in this field. He therefore gave us the possibility of doing work in a new field, which is not strongly developed in [location].* (IRFP host)

> *The whole lab benefited from the experience. We were enriched by new theoretical/analytical perspectives. We were enriched by new ways to deal with data collection, data analysis, lab meeting dynamics and research in general. The lab in general was stimulated to search for collaboration with researchers abroad.* (IRFP host)

These benefits and other outcomes of the program are systematically explored in the next chapter.

5 Outcomes of Participation in IRFP

> *My time as an IRFP [fellow] was transformative both personally and professionally. It was a terrific experience whose benefits I continue to reap even 10 years later in my current position. I met wonderful colleagues with whom I still collaborate, and I feel as though [my former host country] is my second research home although I was only there for just over a year. I have been back numerous times, most recently with students from my home institution…. I'm very grateful for having been awarded an IRFP [fellowship], and have recommended the program to younger colleagues.* (IRFP fellow)

The IRFP program is designed to provide new doctoral recipients with experiences that will have lasting effects on their careers, and by extension, on a broader network of colleagues, associates, and U.S. institutions. Two key objectives of the IRFP program are to further IRFP fellows' global perspective in their field and to enable fellows to forge long-term, sustained relationships with colleagues abroad.[54] Further, IRFP fellows may assume leadership roles in promoting the benefits of international collaboration to younger generations of scientists and engineers.[55]

This chapter describes impacts of IRFP by examining whether and how the international engagement and career trajectories of former IRFP fellows differed from those of their unfunded peers (matched using propensity-score methods detailed in Appendix C). Two sets of outcomes are tested. The first set of outcomes, relating to fellows' subsequent engagement in international collaboration, is directly related to the primary goals of the IRFP program. The second set of outcomes, relating to fellows' subsequent career paths, was examined to understand whether the time spent abroad is detrimental to the later careers of early career scientists and engineers.

The impact analyses are then followed by comparisons of IRFP applicants to a nationally representative sample of STEM doctorate recipients to provide a context in which to understand the outcomes of IRFP fellows and applicants. Finally, the chapter concludes by describing former IRFP fellows' and hosts' reflections on the outcomes of the fellowship.

Specifically, this chapter answers the following questions:

- Does the extent to which former fellows engage in international collaborations differ from those of unfunded applicants?
- Do fellows' post-award career activities and job characteristics differ from unfunded applicants and other STEM graduates in the U.S.?
- What do program participants view as the outcomes of the program?
- Do the outcomes of program participation extend beyond the direct participants?

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54 NSF. 2006a.

55 NSF. 2005. IRFP Program Solicitation. Retrieved from http://www.nsf.gov/pubs/2005/nsf05599/nsf05599.txt

5.1 Key Findings

- There are statistically significant and positive differences between fellows and unfunded applicants on several facets of international research, including: number of international postdoctoral fellowships; number of publications with a foreign co-author; and percentage of publications with a foreign co-author. The fellows' research productivity is consistently higher across all three measures.
- The IRFP fellows' engagement in international research collaborations has not been detrimental to their career opportunities or professional advancement in the U.S: in fact, fellows and their peers were equally likely to hold multiple postdoctoral appointments, and were equally productive researchers, equally likely to hold a faculty rank of assistant, associate, or full professor, and equally likely to be tenured.
- Career outcomes of IRFP fellows, and applicants overall, compare well against national STEM PhD holders on employment, publications, and international collaborations, suggesting that IRFP attracts a talented pool of applicants.
- About four-fifths of fellows (79 percent) reported that participating in IRFP had qualified them for a broader range of career options, and 68 percent said that IRFP had made them more competitive for jobs.
- Nearly three-quarters (71 percent) reported that they had made important connections to researchers in their host country, and had opened up new areas for investigation, and about two-thirds commented that their IRFP fellowship provided the chance to familiarize themselves with the scientific enterprise in their host site and to make substantial advancements in their research (65 and 64 percent, respectively).
- Most fellows reported that the fellowships offer opportunities for professional relationships that endure beyond the fellowship period, either through subsequent collaborations with their hosts, and/or additional communications (46 percent each). Half of all former fellows said that participation in IRFP made them more committed to international research collaboration.
- More than three-quarters of former IRFP fellows reported that post-fellowship, they taught colleagues, students or peers methods learned during their fellowship (78 percent), and shared resources or tools acquired during this time (75 percent).
- Hosts also served as a mechanism for extending the effects of the program to other scientists. Twenty-five percent of former IRFP hosts reported that a collaboration with a U.S. researcher resulted from their participation in the IRFP program.

5.2 Comparison of IRFP Fellows and Unfunded IRFP Applicants

The impact of the IRFP program on its participants was examined by comparing IRFP fellows to a rigorously matched group of unfunded applicants, controlling for number of years since PhD degree, underrepresented minority status, and gender, and also where applicable number of pre-award publications and field of study. Impact models used the propensity-score matching methods

detailed in Appendix C. The overall treatment effect was calculated by taking an average of the estimated treatment effects weighted by the number of treated observations (i.e., the number of awardees) within each stratum. Exhibits display the adjusted (estimated) means for awardees and non-awardees. What emerged are insights into the unique effects of IRFP program. Two sets of outcomes were tested: first, a set of outcomes relating to fellows' subsequent engagement in international collaboration, reflecting the primary goals of the IRFP program; and a second set relating more generally to fellows' career paths.[56]

5.2.1 International Collaborations

The IRFP program is meeting its primary goals to facilitate productive international research collaborations among its awardees. As summarized in Exhibit 5.1, compared to a matched group of unfunded IRPF applicants, IRFP fellows on average were more likely to establish productive international research collaborations. Specifically, statistically significant differences emerged, whereby fellows held a greater number of international postdoctoral fellowships;[57] produced a greater number of publications with a foreign co-author; and produced a higher percentage of publications with a foreign co-author.

IRFP fellows had held an average of 1.1 international postdoctoral fellowships, whereas unfunded IRFP applicants had held an average of 0.63 international postdocs.[58] That the average number for fellows is close to one suggests that the IRFP was likely the only international postdoc they had ever held. The non-zero average for unfunded applicants means that some unfunded applicants did go on (after an unsuccessful application to IRFP) to hold at least one international postdoc. However, the statistically significant difference in the number of international postdocs reveals that some proportion of unfunded applicants never went on to a different (non-IRFP) international postdoc.

On average, IRFP awardees produced 12.8 publications with a foreign co-author, 6 more publications than unfunded applicants. Moreover, a statistically significantly higher percentage of IRFP awardees' publications were internationally coauthored than were those of unfunded applicants (37 and 27 percent, respectively). In terms of the number and rate of internationally co-authored publications, the IRFP program facilitates productive international research collaborations.

[56] The estimates for former IRFP Fellows compared to SDR respondents differ from the IRFP impact estimates shown in this section: in the comparison to SDR sample, covariates were grand mean centered using the average mean of the SDR and IRFP applicants versus the average mean of the IRFP applicants.

[57] The number of international postdoctoral fellowships is a measure of internationalization and not a measure of employment.

[58] This figure includes the IRFP postdoctoral fellowship.

Exhibit 5.1: Fellows' and Unfunded Applicants' Engagement in International Collaboration

Outcomes	Awardee Adjusted Mean	Unfunded Adjusted Mean	Impact Estimate	Impact Standard Error	P value
Work with individuals outside the U.S.					
Number of international postdoctoral fellowships [a]	1.10	0.63	0.47***	0.08	0.000
Any employment outside the U.S. between 2 years after IRFP application and October 1, 2010 [b]	0.45	0.56	-0.11	0.07	0.131
Duration of any employment outside the U.S. during the reference period [h]	4.10	3.14	0.96	0.75	0.201
In current job (as of October 1, 2010), works with individuals located in other countries [c]	0.64	0.57	0.07	0.06	0.200
In current job, work with individuals in other countries includes joint publications and/or jointly-developed products [i]	0.54	0.50	0.04	0.06	0.461
Publications with foreign collaborator					
Number of publications co-authored with a foreign collaborator [d]	12.76	6.69	6.07**	1.99	0.002
Percent of publications co-authored with a foreign collaborator [e]	37.17	26.50	10.67**	3.69	0.004
Fostering international collaboration					
Has mentored others from the U.S. traveling to another country to conduct research [f]	0.59	0.58	0.01	0.07	0.886
Engages in one or more activities to foster international collaboration [g]	0.72	0.64	0.09	0.07	0.204

*p<.05, **p<.01, ***p<.001

EXHIBIT READS: IRFP Awardees (who had completed their fellowship by October 1, 2010) held, on average, 1.10 international postdoctoral fellowships, compared to Unfunded Fellows, who held, on average, .63 international postdoctoral fellowships.

NOTES: Only IRFP Awardees who had completed their IRFP fellowship by October 1, 2010 (including any U.S.-based "re-entry period") were included in these analyses. Notes below show other restrictions for individual outcomes listed.

[a] The IRFP award was included in the count of international postdoctoral appointments. N=937 (387 Awardees, 550 Unfunded Applicants); Missing=10 (3 Awardees, 7 Unfunded Applicants).

[b] N=824 (367 Awardees, 457 Unfunded Applicants); Missing=33 (6 Awardees 27, Unfunded Applicants). For this analysis, "working at the proposed foreign host institution at time of application" (Item C5a) was included as a control. Only IRFP awardees who had applied prior to 2008 were included.

[h] N=375 (167 Awardees 208, Unfunded Applicants); Missing=0.

[c] N=930 (370 Awardees 560, Unfunded Applicants); Missing=10 (3 Awardees, 7 Unfunded Applicants).

[i] N=937 (387 Awardees 550, Unfunded Applicants); Missing=22 (12 Awardees, 10 Unfunded Applicants).

[d] Publications included peer-reviewed journal articles, peer-reviewed conference publications (e.g. abstracts, conference papers, posters), and book chapter(s) (e.g., in edited volumes). N=937 (387 Awardees, 550 Unfunded Applicants); Missing=44 (13 Awardees, 31 Unfunded Applicants).

[e] Publications included peer-reviewed journal articles, peer-reviewed conference publications (e.g. abstracts, conference papers, posters), and book chapter(s) (e.g., in edited volumes). N=937 (387 Awardees, 550 Unfunded Applicants); Missing=48 (12 Awardees, 36 Unfunded Applicants).

[f] Only IRFP awardees who had applied prior to 2008 were included. N=824 (367 Awardees, 457 Unfunded Applicants); Missing=25 (14 Awardees, 11 Unfunded Applicants).

[g] These activities included one or more of the following: Established a program to foster international collaborations; hosted researchers or professional colleagues from another country at my institution; led a delegation of colleagues to visit a research laboratory, university, or business in another country; established or served in a leadership role for an international association for professionals in my line of work. Only IRFP awardees who had applied prior to 2008 were included. N=824 (367 Awardees 457, Unfunded Applicants); Missing=25 (14 Awardees, 11 Unfunded Applicants).

SOURCE: IRFP Applicant Survey–Items C9, D1a, D1b, D4, D4a, D6, D7, D7a, D8, D10.

5.2.2 Other Career Outcomes

The evaluation explored whether the IRFP experience in a foreign country represented a detour with potentially negative consequences for fellows' career paths, and whether or not IRFP affected the type of employment IRFP fellows pursue and their professional outcomes (with a particular emphasis on fellows employed in academia). Although the IRFP award is not expected to affect these outcomes, it is important to test whether or not receiving an IRFP fellow has unintended adverse effects on professional outcomes.

There were no statistically significant differences between IRFP fellows and unfunded applicants on career outcomes. These findings are important for the IRFP program given criticism that time spent abroad may put individuals at a disadvantage relative to their peers who do not engage in these activities.[59] Testing the impact of IRFP on other career outcomes was motivated primarily to determine whether any observed benefits of IRFP resulted in trade-offs in terms of other professional accomplishments. The IRFP goal of fostering international collaboration is not intended to come at the expense of scholarly productivity, professional opportunities, or career advancement.

The findings on career outcomes demonstrate that IRFP does not negatively impact the careers of fellows who engage in a research sojourn abroad. That is, the IRFP experience does not detract from subsequent career productivity and progression along career paths. Indeed, the average number of adjusted publications for fellows (34 publications) was higher than the average for unfunded applicants (27 publications), although this difference was not statistically significant (no exhibit).

There were no statistically significant differences in the types of employers of former IRFP fellows or unfunded applicants. Fellows were no more or less likely than unfunded applicants to work at an educational institution; to be self-employed or a business owner; or to work in the private sector or in public service either in local or state government, in the U.S. Federal government, or in a branch of the U.S. military services. These findings suggest that receiving an IRFP award did not have a measurable effect on the types of employment an individual applicant would have pursued without having completed an international postdoctoral fellowship.

Similar proportions of fellows and unfunded applicants (62 percent each) held a position as a research faculty member, scientist, associate or fellow during the reference week.[60] It is important to note that individuals who held a research position may also have simultaneously held other types of academic positions, including that of a teaching faculty member, a department chairperson, or academic dean.[61] Finally, there were no statistically significant differences with respect to faculty rank or tenure status between IRFP fellows and unfunded applicants.

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59 NSB. 2001.

60 The reference week was the week of October 1, 2010.

61 To ensure that IRFP Fellows and unfunded applicants had an equivalent amount of time to achieve professional and career milestones, all of the analyses reported here controlled for the amount of time that had elapsed since earning the doctorate.

Exhibit 5.2: Types of Employers of Fellows and Unfunded Applicants

Employed in	Awardee Adjusted Mean	Unfunded Applicants Adjusted Mean	Impact Estimate	Impact Standard Error	p value
Educational institution	0.76	0.71	0.06	0.06	0.327
Self employed	0.02	0.01	0.02	0.02	0.290
Private sector	0.11	0.16	-0.04	0.04	0.321
State or local government	0.01	0.01	0.00	0.01	0.671
Federal government	0.06	0.06	-0.01	0.03	0.854
Other	0.03	0.06	-0.03	0.02	0.203

*p<.05, **p<.01, ***p<.001

EXHIBIT READS: 76.1 percent of IRFP awardees (who had completed their IRFP fellowship by October 1, 2010) were employed at an educational institution during the week of October 1, 2010 compared to 70.5 percent of unfunded applicants. This difference of 5.6 percentage points was not statistically significant.

NOTES**:** These items were answered by awardees (who had completed their IRFP fellowship) and unfunded applicants who were working during the week of October 1, 2010 for pay or profit in a non-postdoctoral appointment. N=722 (322 Awardees, 400 Unfunded Applicants), Missing=0.

SOURCE: IRFP Applicant Survey–Items D1c, D2 and D3.

Exhibit 5.3: Fellows' and Unfunded Applicants' Career Outcomes

Outcome	Awardee Adjusted Mean	Unfunded Adjusted Mean	Impact Estimate	Impact Standard Error	P value
Held two or more total postdoctoral appointments [a]	0.60	0.51	0.09	0.06	0.111
Most prestigious grant, award, or honor for research was from an international organization or foreign government [b]	0.22	0.19	0.03	0.06	0.603
Number of post-application publications [c]	34.00	27.40	6.60	3.78	0.081
Currently holds a research faculty, scientist, associate or fellow position (solely or along with another type of academic position, e.g., teaching faculty, department chair, etc.)[d]	0.62	0.62	-0.00	0.07	0.422
Currently has a faculty rank of Assistant, Associate or Full Professor [e]	0.85	0.90	-0.06	0.05	0.424
Currently has tenure [f]	0.55	0.49	0.06	0.08	0.444

*p<.05, **p<.01, ***p<.001

EXHIBIT READS**:** 59.7 percent of IRFP awardees (who had completed their IRFP fellowship by October 1, 2010) had held two or more postdoctoral appointments compared to 50.8 percent of unfunded IRFP applicants. This difference of 8.9 percent was not statistically significant.

NOTES: Impact models included only those IRFP fellows who had completed their IRPF fellowship as of October 1, 2010. Other exclusions are noted below.

[a] N=937 (387 Awardees, 550 Unfunded Applicants), Missing=0.

[b] N=657 (367 Awardees 290 Unfunded Applicants), Missing=28 (8 Awardees, 20 Unfunded Applicants). Includes applicants who had received grant(s) (as a principal investigator or co-principal investigator), prestigious awards or honors based on their research.

[c] Publications included: peer-reviewed journal articles, peer-reviewed conference publications (e.g. abstracts, conference papers, posters), and book chapter(s) (e.g., in edited volumes). N=894 (375 Awardees, 519 Unfunded Applicants), Missing=43 (12 Awardees, 31 Unfunded Applicants).

[d] Respondents could hold other concurrent positions at their academic institution (e.g. president, provost, chancellor, dean, department head or chair, teaching faculty, adjunct faculty). N=535 (247 Awardees, 288 Unfunded Applicants), Missing=0 . Includes applicants who were employed during the week of October 1, 2010 at an educational institution (other than a preschool, elementary, middle, or secondary school or system) during the week of October 1, 2010.

[e] N=495 (232 Awardees, 263 Unfunded Applicants), Missing=1 Unfunded Applicant. Includes applicants who were employed during the week of October 1, 2010 at an educational institution with, and in a position with, a faculty rank system. Excludes applicants working at a preschool, elementary, middle, or secondary school or system.

[f] N=464 (217 Awardees 247 Unfunded Applicants), Missing=1 Unfunded Applicant. Includes applicants who were employed during the week of October 1, 2010 at an educational institution with, and in a position with, a tenure system. Excludes applicants working at a preschool, elementary, middle, or secondary school or system.

SOURCE: IRFP Applicant Survey–Items C9 and D1a, D1c, D2, D2a, D2c, D2d, and D6.

5.3 Comparisons of IRFP Fellows to a National Sample of Doctoral Recipients

To situate IRFP fellows within a broader context, comparisons were made between fellows and respondents to the Survey of Doctoral Recipients (SDR). The SDR is a longitudinal survey of a nationally representative sample of science, engineering, and health (SEM) doctorate recipients. Details of the sampling frame, the SDR data (2006 and 2008 waves), and the analyses conducted are provided in Appendix D. Findings from the comparison of all IRFP applicants to the SDR are presented in Appendix F, and reveal that IRFP applicants are unique in that they are engaged in more international collaborations, and they are successfully engaged in careers.

Given the overall purpose of the SDR (to describe general characteristics of doctoral education and early post-graduation employment for doctoral recipients), it was not designed specifically to address questions that might be important for the IRFP evaluation, including, for example, whether U.S. doctorate recipients in STEM fields co-author research publications with foreign collaborators. The only SDR question related to that type of outcome asked SDR respondents whether they had worked with individuals in countries outside the U.S. Other survey questions addressed more general career outcomes, specifically broad measures of employment, research productivity, and faculty rank and tenure for those working at institutions of higher education (IHEs).

Because any comparisons between survey data from the SDR and from IRFP fellows are descriptive in nature, they do not address impacts of the IRFP. Thus, findings should be interpreted with an understanding that there may be uncontrolled initial differences between IRFP fellows and respondents to the SDR. The analyses reported in this chapter can take into account (that is, statistically control for) the amount of time that has elapsed between when respondents earned their degrees and completed a survey, but the analyses cannot account for differences in prevailing conditions at the time data were collected from IRFP fellows and SDR respondents; specifically, there may well be factors related to economic conditions and employment that differ between the years during which the SDR respondents completed surveys (2006 and 2008), and when IRFP fellows completed surveys in 2011. Also, the SDR excluded individuals living outside the U.S. for sustained periods, whereas the IRFP did not. Finally, because it was not possible to identify individual IRFP fellows in the SDR sample there could be overlap between the samples that renders the groups non-independent, but this overlap would be relatively small.

Comparisons between SDR respondents and IRFP fellows were limited to SDR respondents who had completed a doctoral degree by the reference date specific to that SDR wave (April 1, 2006 in SDR 2006; October 1, 2008 in SDR 2008); and to IRFP fellows who had applied for IRFP prior to 2008 (N=379) and who had completed their IRFP fellowship by October 1, 2010. In addition, analyses controlled for gender, whether or not an individual was a member of an ethnic or minority group traditionally underrepresented in STEM fields (URM), field of study for the first doctorate, and the number of years between receipt of first doctorate and the reporting year of outcomes. Because the analytic samples are different, estimates for IRFP fellows below are different from the IRFP impact estimates presented above; for more detail please refer to Appendix D.

5.3.1 Findings: IRFP Fellows vs. SDR Respondents

The comparison of estimates on career outcomes of IRFP fellows to the national estimates[62] indicate that IRFP fellows' outcomes compare well against national STEM PhD holders on employment, publications, and international collaborations, suggesting that IRFP attracts a talented pool of applicants. As discussed above, these differences cannot be attributed to the IRFP program, but they provide a useful reference point.

[62] The estimates for former IRFP Fellows shown in comparisons to SDR respondents differ from the impact estimates comparing IRFP Fellows to unfunded applicants in the previous section. Covariates in the present analyses were grand mean centered using the average mean of the SDR and former IRFP Fellows versus the average mean of the IRFP Fellows.

Number of postdoctoral positions

Former IRFP fellows had held, on average, a greater number of postdoctoral fellowships (1.7) than U.S. S&E doctoral recipients (.51), a statistically significant difference of 1.2.[63] This finding is not surprising: having received an IRFP fellowship, these individuals already held at least one postdoctoral appointment, and not all STEM doctorates pursue any postdoctoral appointments in their career.

Employment

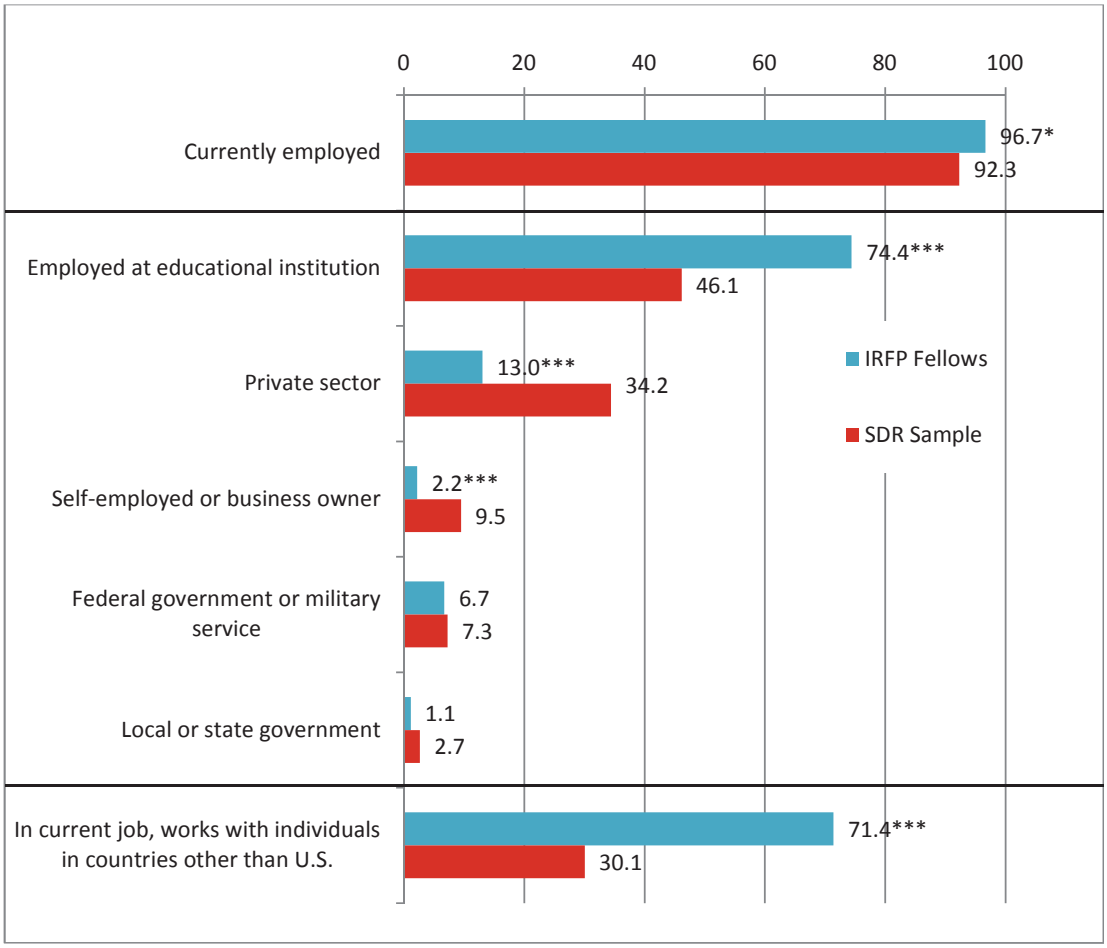
Exhibit 5.4 illustrates the differences in employment circumstances between former IRFP fellows and the SDR sample. IRFP fellows were more likely to work in their current job with individuals in countries other than the U.S. (71 percent) than the typical STEM doctoral recipient (30 percent), a large and statistically significant difference. Virtually all former fellows and virtually all STEM doctoral recipients in the U.S. were employed (97 percent and 92 percent respectively), but IRFP fellows were more likely than the typical STEM doctorate to be working during a specified reference week, a statistically significant difference of 4.3 percentage points.[64]

Former IRFP fellows and SDR respondents also differed with respect to their types of employers. Fellows were more likely than the national pool of PhD holders to be employed at an educational institution (74 percent of fellows versus 46 percent of the SDR sample). Fellows were less likely than SDR respondents to be employed in the private sector (13 percent of fellows versus 34 percent of the SDR sample) or to be self-employed or a business owner (2 percent versus 9 percent).

[63] For comparisons of the number of postdocs held since receipt of first doctoral degree, the SDR 2006 wave of data were used as these data were not available in the 2008 wave.

[64] For IRFP Fellows, the reference week was the week of October 1, 2010; for SDR respondents, the week of October 1, 2008.

Exhibit 5.4: Characteristics of Employment of IRFP Fellows and SDR Respondents



*p<.05, **p<.01, ***p<.001

EXHIBIT READS: 96.7 percent of former IRFP fellows were currently employed during the reference week (October 1, 2010) compared to 92.3 percent of SDR respondents (whose reference week was October 1, 2008). This difference of 4.3 percentage points was statistically significant (p<.0001).

NOTES:

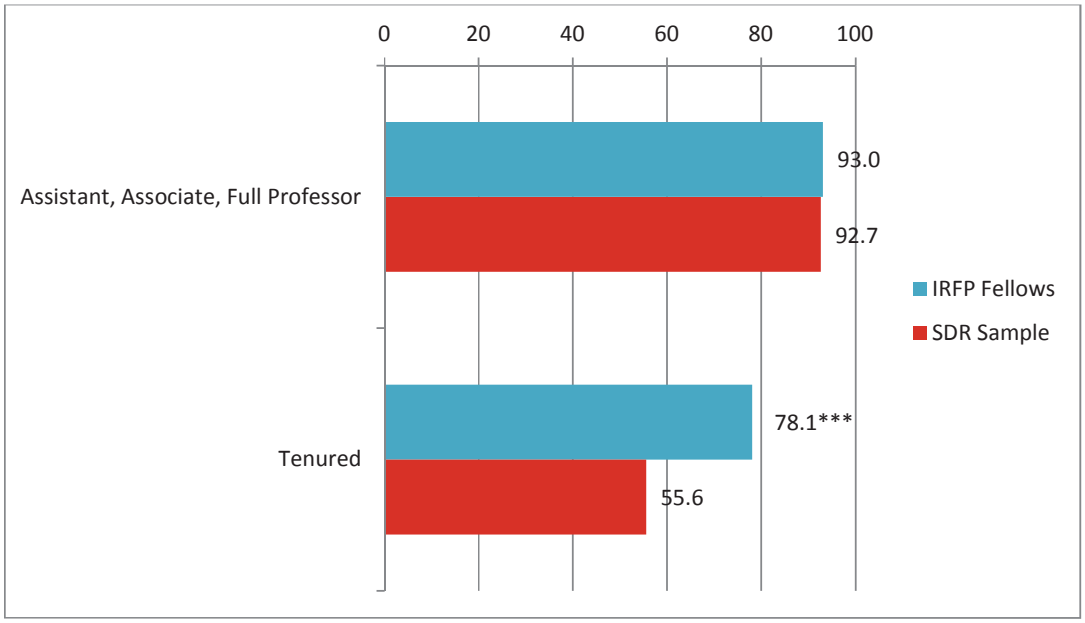
Currently employed: This item was answered by former IRFP fellows who had completed their IRFP fellowship (including any U.S.-based "re-entry period") as of October 1, 2010 (N=379, Missing=0) and by SDR 2008 respondents who had completed a PhD by October 1, 2008 (N=29,974, Missing=0).Private Sector, Self-Employed, Federal Government or Military Service, Local/State Government, Other Employer: This item was answered by all former IRFP fellows who had completed their IRFP fellowship (including any U.S.-based "re-entry period") as of October 1, 2010 and were employed as of October 1, 2010 in a non-postdoctoral position (N=312, Missing=0) and by SDR 2008 respondents who had completed a PhD by October 1, 2008 and were employed during the week of October 1, 2008 (N=26,134, Missing=0). Items from which these data derive differed slightly between the IRFP Applicant Survey and the SDR 2008; thus, Local Government (city, county, school district) and State Government (including state colleges/universities) were combined into a single category for both groups; and U.S. Federal Government and U.S. Military service, activity duty or Commissioned Corps (e.g., USPHS, NOAA) were combined for both groups.

In current job, works with individuals in other countries: This item was answered by former IRFP fellows who had completed their IRFP fellowship (including any U.S.-based "re-entry period") as of October 1, 2010 and were employed during the week of October 1, 2010 (N=363, Missing=0) and by SDR 2006 respondents who had completed a PhD by April 1, 2006 and were employed during the week of April 1, 2006 (N=27,119, Missing=0). This item was not included in the SDR 2008 wave.

SOURCES: IRFP Applicant Survey–Items C9, D1c, D3, and D4. SDR 2008–Items A1, A11, and A12 and SDR 2006–Item A27.

Among respondents working in an institution of higher education, an equal percent of fellows and SDR recipients were in a tenure track positions (e.g., Assistant, Associate, or Full Professor) (93 percent each, Exhibit 5.5). However, a greater percentage of former fellows working at these institutions had earned tenure (78 percent versus 56 percent); this difference was statistically significant.

Exhibit 5.5: Characteristics of Employment in Educational Institutions for Fellows versus SDR Respondents



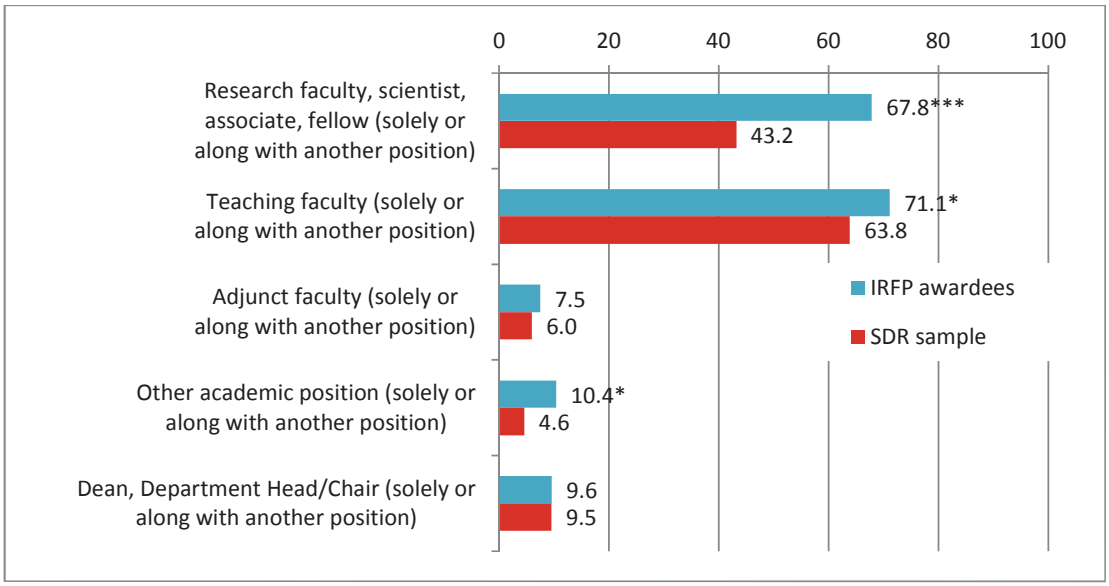
*p<.05, **p<.01, ***p<.001

NOTES: These items were answered by former IRFP fellows who had completed their IRFP fellowship (including any U.S.-based "re-entry period") as of October 1, 2010, who were working in an educational institution during the reference week (Oct 1, 2010) and who did not report working in a preschool, elementary, or secondary school system, and by SDR respondents who had completed a PhD by October 1, 2008, were working in an educational institution during the week of October 1, 2008, and who did not report working in a preschool, elementary, or secondary school system (Item A13). Fellows and SDR respondents indicating that their institution or their position did not have a faculty rank were excluded. (IRFP: N=232, Missing=15; SDR 2008: N=9,501, Missing=0); fellows and SDR respondents indicating that their institution or their position did not have a tenure system were excluded (IRFP: N=215, Missing=16; SDR 2008: N=8,811, Missing=0).

SOURCE: *IRFP Applicant Survey–Items C9, D1c, D2, D2a, D2c, and D2d; SDR 2008–Items A1, A12, A13, A15, and A16..*

Among those individuals employed at an IHE, Exhibit 5.6 below shows the percentages of former fellows and SDR respondents who held one or more of several different types of academic roles. Individual employees reported that they hold multiple roles with different responsibilities, reflecting common roles/responsibilities in IHEs. A statistically significant higher percentage of former IRFP fellows than SDR respondents: held an academic position as a research faculty member, scientist, associate or fellow; held an academic position as a teaching faculty member; and held a type of academic position other than those listed. Other differences were not statistically significant.

Exhibit 5.6: Types of Academic Positions Held (Solely or Along with Another Position) by IRFP Fellows versus SDR



*p<.05, **p<.01, ***p<.001

EXHIBIT READS: Among those working at an educational institution, 68 percent of former IRFP fellows versus 43 percent of the SDR 2008 respondents held a research position (solely or concurrently with another position); this difference was statistically significant.

NOTES: The academic positions are not mutually exclusive: Individuals could select more than one response. For example, individuals could hold a research faculty position and a teaching faculty position simultaneously.

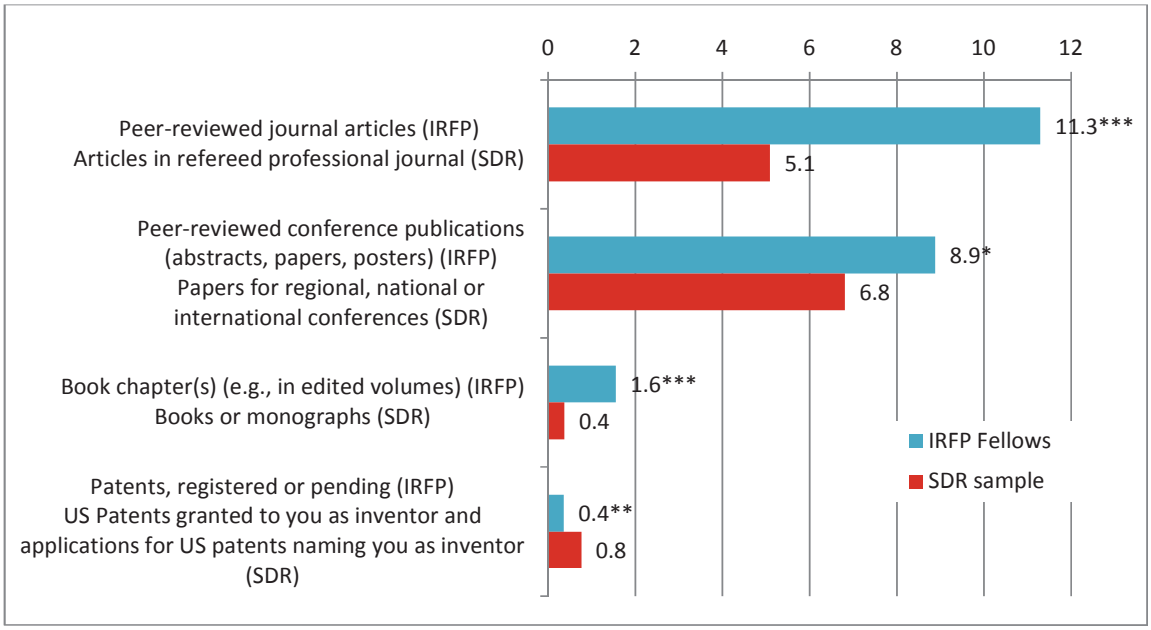
These items were answered by former IRFP fellows who had completed their IRFP fellowship (including any U.S.-based "re-entry period") as of October 1, 2010, were working at an educational institution (other than in a postdoctoral position) during the week of October 1, 2010 and who did not report working in a preschool, elementary, middle, or secondary school or system (N=247, Missing=0) and by SDR respondents who had completed a PhD by October 1, 2008, who were working in an educational institution during the week of October 1, 2008, and who did not report working in a preschool, elementary, or secondary school system (N=11,773, Missing=0).

SOURCES: IRFP Applicant Survey–Items C9, D1c, D2, D2a and D2b. SDR Survey 2008–Items A1, A12 and A14.

IRFP fellows also reported having statistically significantly more publications than SDR respondents. For example, IRFP fellows produced 11 peer-reviewed journal articles on average, compared to an average of 5 produced by SDR respondents (Exhibit 5.7).[65] However, SDR respondents had more patents compared to IRFP fellows (0.8 versus 0.4 patents).

[65] Statistical models controlled for the different time periods about which respondents reported publications.

Exhibit 5.7: Mean Number of Publications for Former IRFP Fellows vs. SDR Respondents[a]



*p<.05, **p<.01, ***p<.001

EXHIBIT READS: The IFRP fellow's model adjusted mean for the outcome "Number of articles published" was 23.32. The model-adjusted mean for the SDR sample was 4.91. IRFP fellows had 18.4 more articles published than the SDR sample. This difference was significantly different than zero (p=<0.0001).

NOTES: The IRFP benchmarking estimate is different from the IRFP impact estimate because in the benchmarking analysis, covariates are grand mean centered using the average mean of the SDR and IRFP fellows versus the average mean of the IRFP fellows. This item was answered by Awardees who as of October 1, 2010 had completed IRFP (including any U.S.-based "re-entry period"; N=381, Missing=7 to 9 Awarded Applicants). SDR: This item was answered by SDR survey takers who had completed a PhD by October 1, 2008 (N=29,953, Missing=0).

[a] SDR asks about publication/patents since 2003 (only in the last 5 years) while IRFP asks about all publication/patents since application to IRFP. Therefore, we should interpret these finding with caution.

Source: IRFP Applicant Survey–Items C9 and D6. SDR Survey 2008–Item C1.

5.4 Fellows' and Hosts' Perception of the Outcomes of IRFP

This last section contributes to a deeper understanding of the outcomes and benefits of the IRFP program. It supplements the findings in the preceding sections by exploring former IRFP participants' reports of their post-fellowship experiences and the outcomes of the program. Below, findings based on former IRFP fellows' survey responses describe the transitions from IRFP to the next stage of their respective careers and the role of IRFP in those transitions. Fellows and hosts describe the publications and professional benefits they attribute to IRFP, whether or not they have sustained their collaboration since the end of the postdoctoral period, and reasons why their collaboration has persisted or not; and both groups discuss how the benefits they derived from IRFP have extended to others.

5.4.1 Entering the Workforce

IRFP fellows had to secure employment upon reentry to the U.S. Virtually all former IRFP fellows (i.e., those who had completed their fellowship by October 1, 2010) had found employment (97 percent) and a large majority (68 percent) were working in a university setting.[66]

> *The IRFP was a major contributing factor to obtaining my tenure-track faculty position. It also was a defining period in development of my research and the experience has provided me with a lot of the tools and skills I need to run a successful research program.* (IRFP fellow)

Most former IRFP fellows reported that they reaped positive career outcomes from their participation in IRFP. About one-third of fellows (32 percent) indicated that IRFP had caused them to consider professional opportunities they would not have otherwise (Exhibit 5.8). Thirty percent of former IRFP fellows reported that obtaining full-time employment after the conclusion of their IRFP fellowship was more difficult than expected. Less than 3 percent of former fellows felt that they had lost an important career or educational opportunity by participating in IRFP. Less than 1 percent of IRFP fellows indicated that participating in IRFP constrained their options.[67]

[66] University setting included a 4-year college or university, medical school (including university-affiliated hospital or medical center), or a university affiliated research institute (IRFP Applicant Survey, Item D2a).

[67] No exhibit. Source: IRFP Applicant Survey, Item F2a

Exhibit 5.8: Fellows' Perceptions of How IRFP Affected Their Post-Fellowship Career Options

Fellows' Report of IRFP's Effects on Broadening Their Range of Post-Fellowship Opportunities [a]	Percent of Fellows (n=378)
IRFP broadened my career options	78.8
Not sure	13.7
IRFP did not broaden my career options	7.4
Fellows' Perceived Effects of IRFP on Career Opportunities & Goals	**Percent of Fellows[b,c,d]**
IRFP made me more competitive for jobs I was interested in [d]	67.7
IRFP made me consider professional opportunities I would not have considered in the past [d]	31.9
Obtaining full-time employment after the conclusion of my IRFP fellowship was more difficult than I expected [b]	29.6
I decided to pursue research in a different discipline than the one I was most familiar with when I began my IRFP fellowship [d]	14.0
My career goals changed from an academic to a non-academic career [d]	8.1
My career goals changed from a non-academic to an academic career [d]	4.1
I lost an important career or educational opportunity by participating in IRFP [c]	2.9

.

NOTES: Only IRFP fellows who had completed their fellowship by October 1, 2010 answered these items.

[a] Missing=6.

[b] N=373, Missing=11 Fellows.

[c] N=367 Missing=17 Fellows.

[d] N=378 Missing=6 Fellows.

SOURCE: IRFP Applicant Survey–Items F2, F3, F6.

A large number (454) of respondents provided additional comments about how IRFP had broadened their career options, and the excerpts presented below illustrate the range of such comments.

> *IRFP allowed me to meet researchers from around the world, broadened my experience working in different systems using different methods, expanded my theoretical background, and sharpened my critical thinking skills by forcing me to question how and why I conduct my research.* (IRFP fellow)

> *I was exposed to a niche of physics where I had the chance to become a pioneer and an expert. I have applied this knowledge to other fields, in particular mathematical finance, where I have been able to use those tools from physics to solve many useful problems.* (IRFP fellow)

> *I had an opportunity to develop in my field of research and explore options for continued work in [country]. These options were not as visible at that time (internationally) and allowed me to remain associated with natural history collections-based research. There have been interesting developments in biodiversity informatics in [country] during the past few years and I have had the privilege to participate in several initiatives and projects. I found opportunities to apply results from these developments to my activities, with IRFP (and post-IRFP) skills and experience noted as highly desired in positions advertised by American and international research institutions.* (IRFP fellow)

It gave me a broader understanding of research in my field, and exposed me to some top-notch methods that I then applied to my own research, with some highly successful results. It also provided me a way to meet many influential scientists in Europe. (IRFP fellow)

5.4.2 Professional and Other Benefits

Former fellows also cited other professional benefits of participation in IRFP. More than two-thirds (71 percent) made important connections to researchers in their host country. A majority of fellows also credited their IRFP fellowship with opening up new areas for investigation (71 percent), with allowing them to make substantial advancements in their research (64 percent), and with making them familiar with the scientific enterprise in their host site (65 percent). Half of all former fellows said that participation in IRFP made them committed to international research collaboration (Exhibit 5.9). Only 2 percent said that they were *more* skeptical about international collaboration than before participation in IRFP.[68]

It provided me with an example of how to lead a group, interact most effectively with collaborators and keep everyone involved on a project interested in the work. (IRFP fellow)

Most fellows also reported a range of personal benefits, including making personal connections in their host country (93 percent), becoming comfortable with another country's culture and traditions, (84 percent), and gaining proficiency in a foreign language (42 percent). Moreover, nearly one-third (33 percent) decided to live outside the U.S. for six months or more after the conclusion of their fellowship.[69]

Exhibit 5.9: Fellows' Reported Professional Benefits of the IRFP Fellowship

	Percent of Fellows (N=378)
I made valuable connections to researchers in the host country	70.6
My work at the host institution opened up new areas of investigation	70.5
I became familiar with scientific enterprise of the host country	65.0
My work at the host institution resulted in a substantial advancement in my research	63.9
I became committed to international research collaboration	49.9
None of the above	3.8

NOTES: Missing Data: 6 Awarded Applicants. Responses do not sum to 100 percent because multiple choices were permitted.
SOURCE: IRFP Applicant Survey–Item F3.

Former hosts also cited a number of positive outcomes of their collaboration with the IRFP fellow. The most frequently cited benefit hosts derived was publishing papers and presenting work at professional conferences: 65 percent of hosts reported that they (or other members of their research group) published papers based on their collaboration with the IRFP fellow, and 56 percent said that one or more conference presentations came about based on this work. In addition, 47 percent of hosts credited the collaboration with acquiring new methodological techniques or new

[68] No exhibit. Source: IRFP Applicant Survey-Item F6. Only IRFP Fellows who had completed their fellowship by October 1, 2010 answered this item (N=384; Missing Data=17).

[69] No exhibit. Source: IRFP Applicant Survey-Item F5. Only IRFP Fellows who had completed their fellowship by October 1, 2010 provided data on personal benefits (N=378; Missing Data=6)

theoretical approaches. For nearly one-third of hosts, working with an IRFP postdoctoral fellow enhanced their interest in collaborating with researchers from the U.S. Finally, for 12 percent, hosting an IRFP fellow was their first ever collaboration with a U.S.-trained researcher.

Exhibit 5.10: Hosts' Reported Benefits of Collaborating with IRFP Fellow

Hosts' Perceived Benefits of Working with IRFP Fellow	Percent of Hosts (N=326)
Published papers based on work with this fellow	65.0
Gave one or more conference presentations based on the collaborative work	55.8
Learned new methodological/analytical techniques or theoretical approach	47.2
Enhanced my interest in collaborating with U.S. researchers	32.8
Changed the direction of some research projects in my group	31.9
Established or renewed collaboration(s) with other U.S. researchers	31.3
Obtained funding based on the collaborative work	26.1
Other U.S. researchers were more interested in collaborating with me	22.4
Became more familiar with the research enterprise in the U.S.	20.6
Hosting an IRFP fellow was the first time I had collaborated with a researcher trained in the U.S.	12.3
None	8.9
Improved my ability to communicate in English	8.6

NOTES: Missing Data: 2 Hosts. Responses do not sum to 100 percent because multiple choices were permitted.
SOURCE: IRFP Host Survey–Item E2.

Hosts' elaborations provide some insight into these benefits.

> *Collaboration was great and we have identified a very interesting area of collaboration. Interaction with the fellow in small meetings and in lab meetings was great. She has now a very strong and interesting database with which we will start publishing and will develop new collaborations. It was interesting to see the different approaches to many logistic aspects of research and to learn from these differences. The Postdoctoral fellow stimulated my students to think in different directions, to try different statistical analyses. She helped them with their English writing.* (IRFP Host)

> *[The fellow] contributed to the intellectual life in my laboratory by interacting with my graduate students, demonstrating laboratory techniques to them, and providing a broader perspective on the research field. The work we did was successful although it still has not reached the publication stage.* (IRFP Host)

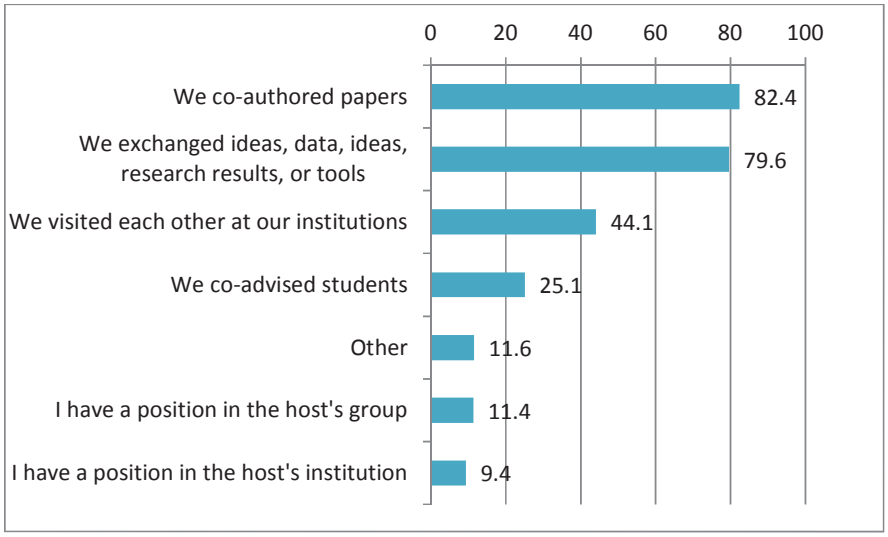
> *There was an excellent confluence between the group's direction and the background of the fellow, which resulted in a scientifically productive project which benefited all.* (IRFP Host)

5.4.3 Sustained Collaborations

Of the former fellows (1992–2009) who had completed their IRFP postdoctoral fellowship, 46 percent had since collaborated on research with their former host, and an additional 46 percent had communicated with their host after the fellowship period.[70] During the continued collaborations (Exhibit 5.11), former fellows and hosts co-authored papers (82 percent), exchanged ideas, data, results or tools (80 percent) and visited each other at their respective institutions (44 percent). In some cases, continued collaboration extended to co-advising students (25 percent). Eleven percent of former fellows reported that they held a position with their former host's group, and 9 percent held a position at the same institution as their former host.

> *My career was completely changed with that experience. I believe that research experience was the major factor in every career move I have made since then. Currently I have numerous collaborators from that research group, as well, and this continues to enrich my life/ professional experience* (IRFP fellow)

Exhibit 5.11: Types of Collaboration between Fellows' and Hosts after the End of the IRFP Fellowship



NOTES: Only IRFP fellows who had completed their fellowship by October 1, 2010 and who reported having collaborated with their former host on a research project since the end of their IRFP fellowship answered this item (N=179, Missing=0). Results do not sum to 100 percent because multiple choices were permitted.
SOURCES: IRFP Applicant Survey–Item F1a.

[70] No exhibit. Source: IRFP Applicant Survey-Item F1. Former IRFP Fellows were asked to report any collaboration or communication with their host since the end of the fellowship and October 1, 2010, the reference date used throughout the IRFP Applicant Survey (N=378, Missing=6).

More than half of fellows still collaborating with their host reported that the most recent collaboration with their former host occurred within the past six months (52 percent, Exhibit 5.12).

Exhibit 5.12: Timing of Most Recent Communications and Collaborations

How Recently Did the Most Recent Collaboration Occur?	Percent of Fellows (n=179)
Within the past 6 months	52.1
3 or more years ago	25.7
1-2 years ago	12.9
Within the past 12 months	9.4

NOTES: Percents reported are weighted to reflect non-response. Only fellows who had completed their IRFP postdoctoral fellowship by October 1, 2010 and who reported having collaborated with their former host on a research project since the end of their IRFP fellowship were asked these questions. Missing Data: 6 Awarded Applicants.
SOURCE: IRFP Applicant Survey–Items F1, F1b.

Among those fellows reporting a collaboration within the past six months, 53 percent were from the 1992 to 2004 IRFP cohorts (i.e., the first 12 years of the program); nearly half (47 percent) were from the 2005 to 2009 IRFP cohorts, the most recent four years of the IRFP program for which data were collected. More than half of those reporting that their most recent collaboration was three or more years ago were fellows from the 1992 to 1997 cohorts (Exhibit 5.13), and not surprisingly, no fellows from the 2004 to 2007 cohorts reported recent collaborations with former hosts three or more years ago.[71]

[71] Note that IRFP Fellows from the 2008 and 2009 cohorts could not have had a collaboration with the most recent contact taking place three or more years prior to the survey reference date of October 1, 2010; any collaboration after the end of their fellowship would logically have had to occur more recently than three or more years ago.

Exhibit 5.13: Former IRFP Fellows' Most Recent Collaboration with Former Hosts by Cohort Year

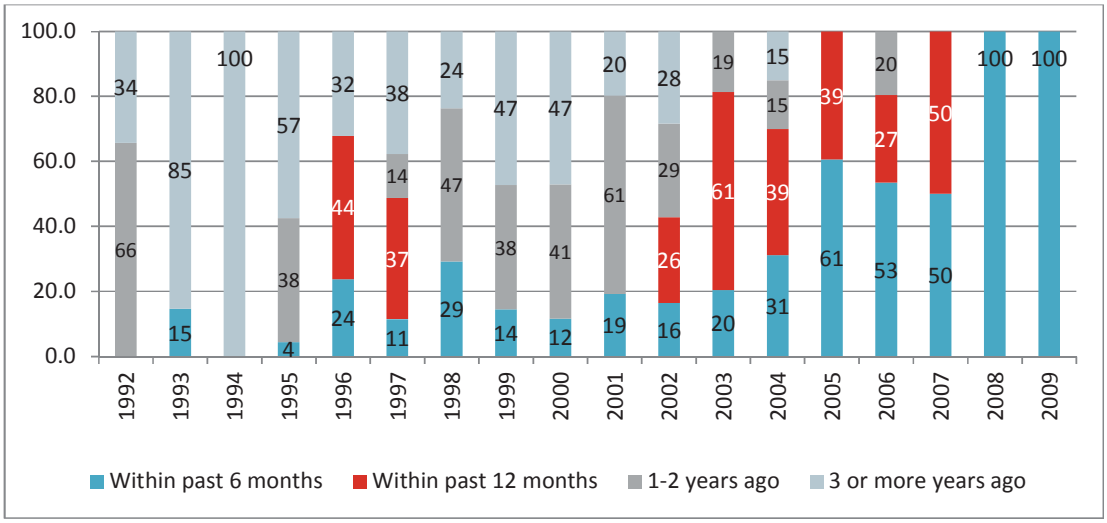


EXHIBIT READS: Among those IRFP fellows in the 1992 cohort who reporting collaborating with their former host since the end of their IRFP fellowship, 66 percent had done so within the past 1–2 years and 34 percent had done so 3 or more years ago.
NOTES: Only fellows who had completed their IRFP postdoctoral fellowship by October 1, 2010 and who had collaborated with their former host since the end of IRFP fellowship were asked this question (N=179, Missing=6).
SOURCE: IRFP Applicant Survey–Item F1b.

The reasons fellows cited for not pursuing post-fellowship collaboration included diverging research interests (51 percent, Exhibit 5.14), being too busy (34 percent), a lack of action by the host to pursue a collaboration with the fellow (28 percent), and either the fellow or host lacked sufficient funding (25 percent). One-fifth of fellows reported that that further collaboration would not benefit them.

Exhibit 5.14: Reasons IRFP Fellows Have Not Collaborated with Former Host

Reasons Indicated	Percent of Fellows
Our research interests diverged	51.2
One (or both) of us is too busy with other projects	34.1
My host did not actively pursue or maintain further collaboration with me	27.8
One or both of us lacked funding needed to maintain collaboration	24.9
I did not think that further collaboration would be beneficial for me	20.3
Other	19.7
Geographic distance has hindered further collaboration	18.2
Political or cultural differences have hindered further collaboration	1.4
Language differences have hindered further collaboration	0.0

NOTES: Only fellows who had completed their IRFP postdoctoral fellowship by October 1, 2010 and indicated (Item F1) that they had not collaborated with their host were asked this question (N=199, Missing=0).
SOURCE: IRFP Applicant Survey–Item F1c.

5.4.4 Post-IRFP Publications

IRFP fellows were productive researchers during and after their fellowship, producing an average of 31 publications (including peer-reviewed journal articles, conference publications and book chapters). Moreover, 40 percent of these publications were produced with a foreign co-author—and 26 percent were produced with their IRFP host (Exhibit 5.15).

Exhibit 5.15: IRFP Fellows Post-IRFP Publications

	Mean	Standard deviation
Mean number of post-IRFP publications		
Patents, registered or pending	0.6	2.8
Peer-reviewed journal articles	16.4	20.7
Peer-reviewed conference publications (e.g., abstracts, conference papers, posters)	12.7	26.7
Book chapter(s) (e.g., in edited volumes)	1.5	3.6
Total publications (excluding patents)	30.5	41.3
Total publications with foreign colleague (excluding patents)	12.5	23.1
Total publications with IRFP host (excluding patents)	5.1	8.5
Mean percent of post-IRFP publications with foreign collaborator		
Patents, registered or pending	2.1	15.5
Peer-reviewed journal articles	39.3	36.7
Peer-reviewed conference publications (e.g., abstracts, conference papers, posters)	28.2	40.7
Book chapter(s) (e.g., in edited volumes)	14.1	35.2
Mean percent of all publications (excluding patents)	40.0	34.9
Mean percent of post-IRFP publications with former IRFP host		
Patents, registered or pending	0.7	8.7
Peer-reviewed journal articles	25.2	33.9
Peer-reviewed conference publications (e.g., abstracts, conference papers, posters)	18.6	34.8
Book chapter(s) (e.g., in edited volumes)	7.3	25.6
Mean percent of all publications (excluding patents)	26.4	33.3

EXHIBIT READS: Former IRFP fellows who had completed their fellowship by October 1, 2010 produced an average of 0.6 patents between the time of their application and October 1, 2010.
NOTES: Weighted means and standard deviations are reported. Unweighted N reported. Only IRFP fellows who had completed their fellowship by October 1, 2010 answered this item.
SOURCE: IRFP Applicant Survey–Item D6.

5.5 Effects of IRFP Extending Beyond the Fellow and Host

This section explores how the benefits of IRFP diffused beyond the fellow to his or her colleagues, the effect of IRFP on former hosts' likelihood of subsequent collaboration with their former postdoctoral colleagues, and other benefits hosts reported via open-ended comment. Once IRFP fellows returned to the U.S., they have had the opportunity to share with colleagues any new skills, data, or methods acquired during their IRFP fellowship, and they have the opportunity to foster new international collaborations among their colleagues.

I recommend the program most highly to every grad student who comes through my office (I have also led informal postdoc workshops where I strongly encourage students to apply). The opportunity to spend an extended amount of time dedicated to research in a different cultural setting (in my case, with the top specialists in the field) was an incredible experience. I moved on to the job market with renewed energy, new perspectives on my research, and a greater appreciation for international collaboration (and a stronger CV...). (IRFP fellow)

More than three-quarters of former IRFP fellows shared resources or tools acquired during their postdoc abroad and taught colleagues, students or peers methods learned during this time (Exhibit 5.16).

Exhibit 5.16: Sharing of IRFP Benefits by IRFP Fellows

Activities Undertaken by Former IRFP Fellows' to Share Benefits of Their Fellowship	Percent who Engaged in Activity
Taught colleagues, students, or peers research methods that you learned during your IRFP fellowship	78.1
Shared with your colleagues resources or tools that you collected developed during your IRFP fellowship	75.4

NOTES: Only fellows who had completed their fellowship by October 1, 2010 were presented with this item (N=384, Missing Data: 6 to 9 Felows). Results do not sum to 100 percent because multiple choices were permitted.
SOURCE: IRFP Applicant Survey–Item D9.

More than half of former IRFP fellows reported that the methods or ideas that they had learned benefited others at their institution (64 percent). Forty-one percent reported that samples or tools from their fellowship benefited others in their institution. Smaller proportions of fellows reported that their enthusiasm may have spread to others: 23 percent reported that their peers became interested in international collaboration and 15 percent reported that members of their research group in the U.S. began an international collaboration (Exhibit 5.17).

Exhibit 5.17: Benefits to Others as Reported by IRFP Fellows

Benefits of IRFP for Colleagues of former IRFP Fellows	Percent
Research methods or ideas that I learned benefited others in my institution	64.1
Sample that I collected or tools that I developed benefited others in my institution	40.8
My peers became interested in international collaboration	23.3
Others in my research group (in the U.S.) began an international research collaboration	15.4
Researchers that I met during my fellowship joined my research group in the U.S.	8.6
Other	7.1
None of the above	19.4

NOTES: Only IRFP fellows who had completed their fellowship by October 1, 2010 answered this item (N=378, Missing=6). Results do not sum to 100 percent because multiple choices were permitted.
SOURCE: IRFP Applicant Survey–Item F4.

Hosts also served as a mechanism for extending the effects of the program to other scientists. Twenty-five percent of former IRFP hosts reported that a collaboration with a U.S. researcher resulted from their participation in the IRFP program (Exhibit 5.18)

Exhibit 5.18: Hosts Collaborating With a Former IRFP Fellow's Colleague or With Other U.S. Researcher(s)

	Percent
With this individual's former faculty advisor	14.7
With graduate students who work with this former IRFP fellow	8.3
With postdoctoral fellows who work with former IRFP fellow	8.0
With other researchers who work with this former IRFP fellow	26.5
None of the above	55.9
Currently collaborating with other U.S. researchers	82.1
A collaboration with a U.S. researcher resulted from hosting the IRFP fellow[a]	24.6

NOTES: These items were answered only by hosts whose IRFP fellows' fellowships had concluded (N=313, Missing=4)
[a] This item was answered by hosts whose IRFP fellows' fellowships had concluded and who reported a current collaboration with other U.S. researchers (i.e., not a direct colleague of their former IRFP fellow; N=257, Missing=1)
SOURCE: IRFP Host Survey–Items B7, D3a, D3b, D3d.

These benefits of the program as well as the other findings from the evaluation are tied to the specific goals of the program in the concluding chapter.

6 Conclusions

Findings from this evaluation provide ample evidence that IRFP fulfills its promise of providing opportunities for collaborations among U.S. and foreign researchers in settings abroad. Unique among NSF postdoctoral programs, IRFP provides early career post-PhD scientists the opportunity to engage in overseas scientific research and collaborations with scientists outside the U.S. This study of IRFP examined the characteristics and motivations of IRFP participants, the opportunities for research and professional growth provided through IRFP, and the professional outcomes related to the program.

The evaluation found evidence that the IRFP program is meeting its goals to:

- Introduce early career scientists and engineers to opportunities for international research collaboration;
- Build research capacity and global perspective of participants; and
- Forge long-term relationships between U.S. and foreign S&E researchers.

Below we summarize contributions the program has made in each of these areas, and then discuss some general conclusions from the evaluation.

6.1 Opportunities for International Research Collaboration

IRFP is a selective program that offers international research opportunities to individuals who are interested in international research collaborations. Both unfunded applicants and successful fellows reported being attracted to the program because it offered them an opportunity to conduct research with individuals in foreign settings and at institutions outside the U.S. Foreign hosts reported that the proposed research topics were engaging, as was the potential to create international collaborations in their research group.

IRFP attracts a talented pool of applicants from among the pool of national STEM PhD holders, who reported interest in the contributions that opportunities abroad may make in their own research. After their experiences, half of all former fellows said that participation in IRFP made them more committed to international research collaboration.

IRFP fellows indicated that they engage in research collaborations while abroad, and an overwhelming majority of fellows were satisfied with the quality of research conducted as part of IRFP and the timing of the fellowship with respect to their career goals. Hosts and fellows agreed they worked collaboratively on developing project ideas and hypotheses, interpreting results, and planning follow-up work. A majority of fellows also credited their IRFP fellowship with allowing them to make substantial advancements in their research.

Further, IRFP offers fellows broad range of professional opportunities beyond the opportunity to conduct quality research at their host institution, including opportunities to network with colleagues from other than their host institutions, attend lectures in their field, attend conferences, and give talks at their host institution.

Hosts provided positive comments about their experiences with IRFP and the fellows specifically. A majority agreed that their IRFP fellow had sufficient knowledge and expertise for the research conducted and that the fellow integrated well with their research group. Further, hosts noted that IRFP fellows compared favorably to other postdoctoral fellows with whom hosts had worked.

6.2 Research Capacity and Global Perspectives

A unique feature of IRFP is its focus on providing international research experiences for postdoctoral fellows. Individuals who participate in IRFP develop their knowledge and research skills, broaden their perspectives, and contribute to the global understanding and research enterprise more broadly. A majority of fellows credited IRFP with opening up new areas for investigation and familiarizing them with the scientific enterprise in their host site. Three-quarters of fellows also observed that IRFP qualified them for a broader range of career options, and two-thirds felt it contributed to making them more competitive for jobs.

The evaluation provides evidence that these experiences lead to greater levels of international research engagement among fellows. Fellows were consistently higher than unfunded applicants on several facets of international research, including the number of international postdoctoral fellowships, the number of publications with a foreign co-author, and the percentage of publications with a foreign co-author. The fellows' research productivity is consistently higher across all three measures.

Importantly, this international focus did not come at the expense of research productivity or career advancement. Specifically, fellows and their peers were equally likely to hold multiple postdoctoral appointments, and were equally productive researchers, equally likely to hold a faculty rank of assistant, associate, or full professor, and equally likely to be tenured.

Further, the program demonstrates potential to reach beyond the immediate participants. More than three-quarters of former IRFP fellows shared resources or tools acquired during their international postdoctoral fellowship and taught colleagues, students or peers methods learned during this time.

6.3 Long-Term Relationships between U.S. and Foreign Researchers

The relationships developed during IRFP seed subsequent professional collaborations and activities. Many IRFP fellows developed professional relationships that endured beyond the fellowship period, either through subsequent collaborations with their hosts, and/or additional communications. The continuing collaborations reported by a large proportion of former fellows and hosts included co-authored papers and exchanged ideas, data, results or tools. They also visited each other at their respective institutions, and co-advised students. Also, there is evidence that the collaborations may be seeding networks, as fellows interact with hosts' research groups, and as hosts establish collaborations with other U.S researchers as a result of their participation in the IRFP program.

6.4 Conclusion

The evaluation demonstrated that individuals derive important benefits from the program, both on an individual and a collective basis. Former fellows and hosts strongly endorsed the IRFP program, and would recommend IRFP to their students and colleagues. IRFP offers an opportunity for interested researchers to develop their international research collaborations early in their careers. The experiences during IRFP seed relationships that often are sustained and that generate international research collaborations across geopolitical boundaries. As such, IRFP has a central role in NSF's efforts to respond to the NSB's charge that NSF play a leadership role in international S&E research and education activities, and specifically in promoting international S&E among early career scientists and engineers.[72]

> *This is a great program. It helped launch my career. I didn't know the quality of people I would be working with, but really got very lucky. They took me under their wing, and I met many researchers at several different institutions over the course of the fellowship. The country benefits greatly from a program like this. During the 13 years since completing the fellowship, I've been working on various … research projects as a principal investigator. The small amount of funds that the U.S. government invested in me during the IRFP I believe enabled my subsequent research contributions to these government agencies and goals.... Keep funding this program. It has a great deal of payback.* (IRFP fellow)

[72] NSB. 2000.

Appendix A: NSF-Generated IRFP Highlights

NSF Highlights: 2010

Investigating Variation in Natural Zebrafish Populations

Highlight ID: 21515, Version: AC/GPA

Andrew Whiteley (second from left) teamed up with another U.S. researcher (Dr. Richard Mayden, right), a graduate student from Bangladesh (Shobnom Ferdous, left), and an ichthyologist from Dhaka University in Bangadesh (Dr. Ahmed Abu Tweb Ahmed, third from left) to sample natural populations of zebrafish throughout Bangladesh.

Credit: Matiul Mahmud Munna

Image Provided by awhiteley@nrc.umass.edu

NSFForm1515

Zebrafish captured in the wild in a stream near Chittagong, Bangladesh.

Credit: Andrew Whiteley, University of Massachusetts Amherst

Image Provided by awhiteley@nrc.umass.edu

NSFForm1515

Sampling zebrafish in a rice paddy in Bangladesh. Wild zebrafish occur in standing water like this rice paddy pond, or in streams with fast flowing currents.

Credit: Richard Mayden, St. Louis University

Image Provided by awhiteley@nrc.umass.edu

Adaptive evolution, changes in a species over time that enable it to adjust to an environment, has been studied extensively across many species. Technological advances have now made it possible to examine this evolution at the genomic level to address ecological evolution. Dr. Andrew Whiteley is using a fish species, zebrafish, in his research to determine how this species has adapted (using genes and physiology) to two different aquatic environments, fast moving rivers and calmer lakes. The zebrafish, which has over 75% of its genome sequenced, has been a useful vertebrate model organism to both developmental biologists and for biomedical research.

The goal of this research is to provide a link between the fields of conservation genetics and evolutionary ecology. By advancing knowledge in both fields there will be an increased understanding of the relationship between phenotypic adaptation, gene expression, and genotype variations. This objective includes first, looking at gene frequencies for thousands of functional genes with newly developed genome technologies. A second step will involve examining expression for genes that appear to be important for adaptation to still or moving water. Ultimately this study will provide information on the evolutionary history of zebrafish in India and an initial understanding of conservation units in this fish species.

Dr. Whiteley was supported from by an International Research Fellowship. Dr. Whiteley is working closely with Dr. Louis Bernatchez (knowledgeable in applying population genetics and genomic techniques to wild fish populations), Dr. Uttam Sarkar (Senior Scientist at the National Bureau of Fish Genetic Resources), Dr. M Arunachalam (Manonmaniam Sundaranar University), and Dr. Helga Guderley (expert in muscle physiology). Collaboration is between

the Université Laval in Canada, and at the National Bureau of Fish Genetic Resources in India.

Primary Strategic Outcome Goal:

- International
- Biology

Secondary Strategic Outcome Goals: Learning

- Postdoctoral Education and Fellowships
- Professional and Career Development

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *ReporttoCongress:TransformativeResearch attheNationalScienceFoundation,April16,2008* *and* *ImportantNotice130: TransformativeResearch*

No

What is the intellectual merit of this activity?
This project aims to learn more about wild populations of an important laboratory model organism, the zebrafish (Danio rerio). Little is known about the distribution and evolutionary history of this species.

What are the broader impacts of this activity?
MeritReviewBroaderImpactsCriterion:RepresentativeActivities,July2007

To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
This research establishes collaborations with researchers in India to facilitate integration of this important laboratory model with its natural history.

O/D/OISE 2010

NSF Award Numbers:
0601864

Award Title:	International Research Fellowship Program: Integrated Genomic Analysis of Neutral and Adaptive Variation in Natural Populations of the Zebrafish
Start Date:	06/01/2007
Expires:	11/30/2009
Awarded Amount to Date:	$160,397
PI:	Andrew Whiteley, awhiteley@eco.umass.edu
Institution Name:	Whiteley Andrew
R State Code:	
PE Codes:	7316

The quest of king penguins: orientation in a crowded environment

Highlight ID: 21520, Version: AC/GPA

King penguin colonies can stretch over several kilometres. Each breeding pair vigorously defends a square-meter residence area where they incubate an egg and brood a chick. When the chicks are several weeks old, they are left unattended in the groups of other chicks while the parents search for food. Here is the group of 10-12-month-old chicks next to breeding adults.

Credit: Anna Nesterova

Image Provided by apnesterova@gmail.com

NSFForm1515

Many of us at one point or another in life were lost in the crowd desperately searching for our family or friends, looking out for some familiar landmarks and not seeing anything because there were people everywhere. If only we knew how to search! King penguins (*Aptenodytes patagonicus*) seem to solve problems like this quite easily and even without the help of cell phones. These birds have an extraordinary ability to locate a square-meter residence area among as many as 100,000 individuals on the flat beaches of sub-Antarctica.

My research concerns animal navigation in "crowded" environments. The close proximity of large numbers of animals in colonial species can obstruct any locally available cues (e.g., visual, acoustic) making navigation especially challenging. Presently, I am trying to unravel the mechanisms of short-range navigation that allow king penguins to find their place in the colony in spite of all the odds. The flightless nature of penguins adds an additional layer of complexity for orientation in the colony, but at the same time it makes the situation similar to what we, humans, might face.

Our research group has demonstrated that even at the age of 10 months, king penguin chicks have well-developed navigational abilities. They can come back to their exact place in the colony even if displaced a half kilometre away. In our field experiments we manipulate the availability of visual, acoustic and magnetic cues, and test the ability of penguin chicks to return to their place in the colony after a displacement. The results, obtained using high-precision GPS tracking, suggest that visual and acoustic cues are important for chick's navigation. Chicks pay special attention to the global features of the landscape (e.g. hills, lakes), but disregard local features (e.g., whale skeleton, rock formations) when homing. The sound of the colony can be a

In order to be found and fed by the parents, chicks must remain at the specific place in the colony called rendezvous zone. However, the predators can drive chicks away from these zones. It is essential for chicks survival to navigate back to their place in the colony.

Credit: Anna Nesterova

Image Provided by apnesterova@gmail.com

NSFForm1515

Chicks have their own games. Sliding down an old whale carcass is a popular activity.

Credit: Anna Nesterova

Image Provided by apnesterova@gmail.com

NSFForm1515

determining factor in the chicks' initial orientation. On the other hand, the distortion of magnetic cues has no effect on chicks' homing ability.

To address navigation questions in adult king penguins, we collaborate with our colleagues from CNRS at Strasbourg, France to analyze birds' movement patterns in the colony. We found that while younger birds (<8 years old) prefer to move when at least some visual cues are available, older birds can enter the colony even in complete darkness. How older birds manage to manoeuvre among thousands of individuals to a specific place in the colony during dark nights still remains a mystery.

Primary Strategic Outcome Goal:

- International
- Biology

Secondary Strategic Outcome Goals: Learning

- Postdoctoral Education and Fellowships
- International Research Experiences for Undergraduate & Graduate Students

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see Reportto Congress:TransformativeResearchatthe National ScienceFoundation,April16,2008 and Important Notice130:TransformativeResearch*

No

What is the intellectual merit of this activity?
The project assesses the use of visual landmarks, familiar routes, and olfactory cues and addresses an aspect of animal behaviour (short range spatial orientation) which has received relatively little scientific attention.

What are the broader impacts of this activity? MeritReviewBroaderImpacts Criterion:RepresentativeActivities,July2007

How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
This project promotes cross-fostering of ideas among scientists of different countries with unique resources and expertise. The principle investigator interacted closely with a graduate student in the field and also co-supervised undergraduate students at the research center.

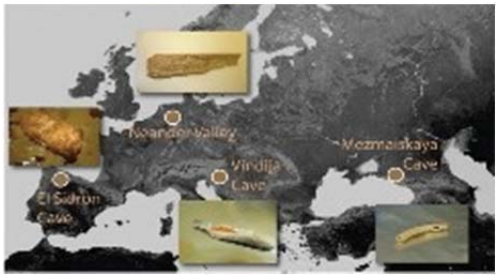
O/D/OISE 2010

NSF Award Numbers:
0700939

Award Title:	International Research Fellowship Program: The Quest of King Penguins: Orientation in a Crowded Environment
Start Date:	06/01/2008
Expires:	08/31/2010
Awarded Amount to Date:	$108,610
PI:	Anna Nesterova, apnesterova@gmail.com
Institution Name:	Nesterova, Anna
State Code:	PA PE
Codes:	7316

New insights into human evolution from ancient DNA

Highlight ID: 21521, Version: AC/GPA



Location and images of some of the Neandertal bones used for genetic analysis by Good and colleagues.

Credit: Adrian Briggs and Johannes Krause, Max Planck Institute for Evolutionary Anthropology

Image Provided by jeffrey.m.good@gmail.com

NSFForm1515

Dr. Jeffrey Good.

Credit: Jeffrey Good, University of Montana, Missoula

Image Provided by jeffrey.m.good@gmail.com NSF Form1515

Much of what is currently known about the evolutionary history of humans is based on analyses of fossilized remains and associated artifacts of ancient humans. However, despite fairly rich archeological and fossil records, relatively little is known about our closest relatives, the Neandertals. Remains of Neandertals begin to appear in the European fossil record about 400,000 years ago. In Europe, Neandertals began to come in to contact with modern humans migrating out of Africa approximately 50,000 years ago and ultimately disappeared around 30,000 years ago. Analysis of genetic information (i.e., DNA sequences) from Neandertals and other ancient human remains holds great promise for further unravelling the details of human evolutionary history, but retrieval of ancient DNA has proven to be very technically difficult.

As an NSF International Research Fellow, Dr. Jeffrey Good has worked closely with pioneering ancient DNA researcher Dr. Svante Pääbo, Dr. Johannes Krause, Dr. Adrian Briggs and other scientists at the Max Planck Institute for Evolutionary Anthropology (MPI-EVA) in Leipzig, Germany to recover genetic information from several ancient bones (70,000 - 30,000 years old) from parts of Europe and Asia. Dr. Good and colleagues found that Neandertals from Europe and western Asia had very low levels of genetic variation when compared to modern humans, indicating that Neandertals existed in relatively small populations prior to their extinction. A key component of this research was the development of a novel laboratory technique for retrieving highly degraded DNA from fossil bones. Dr. Adrian Briggs, who was a graduate student working with Dr. Good at the time of the research, developed this groundbreaking new method.

A follow-up study on a ~40,000 year-old finger bone of a small child from southern Siberia provided an even more surprising result: examination of a small part of the genetic code retrieved from this Siberian bone revealed an unexpectedly high number of genetic differences when compared to both Neandertals and to present-day

humans. Remains from Neandertals and archeological artifacts associated with modern humans from approximately the same time period have also been found in this region. There were no further skeletal clues to the child's identity but these genetic differences suggest that the bone may derive from a previously unknown population of humans. Ongoing genetic research at the MPI-EVA should help clarify the evolutionary relationship of this enigmatic bone relative to Neandertals and modern humans.

Collectively, this research has provided considerable insights into human evolutionary history and has laid the groundwork for future genetic inquires into human evolution based on ancient DNA. Dr. Good and colleagues have published the results of this work in the high-profile scientific journals *Cell*, *Science*, and *Nature*. These works have also been highlighted in a diverse array of popular press forums including the New York Times, BBC News, and The Washington Post, sparking intense public interest in human evolution.

Primary Strategic Outcome Goal:

- International
- Biology

Secondary Strategic Outcome Goals: Learning

- Postdoctoral Education and Fellowships

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: Transformative Research*

Yes

This research has provided considerable insights into human evolutionary history and has laid the groundwork for future genetic inquires into human evolution based on ancient DNA.

What is the intellectual merit of this activity?
This took advantage of recent advances in primate comparative genomics and it addressed central theoretical issues concerning sexual selection and mating systems in great apes. This research will be of great benefit to those interested in the evolution of humans and other apes, especially in terms of male reproductive genes.

What are the broader impacts of this activity? MeritReviewBroaderImpacts Criterion:RepresentativeActivities,July2007

Will the results be disseminated broadly to enhance scientific and technological understanding?

Dr. Good and colleagues have published the results of this work in the high-profile scientific journals *Cell*, *Science*, and *Nature*. These works have also been highlighted in a diverse array of popular press forums including the New York Times, BBC News, and The Washington Post, sparking intense public interest in human evolution.

O/D/OISE 2010

NSF Award Numbers:
0754461

Award Title:	International Research Fellowship Program: Evolutionary Reproductive Genomics in Humans and Great Apes
Start Date:	05/15/2008
Expires:	10/31/2010
Awarded Amount to Date:	$169,000
PI:	Jeffrey Good, jeffrey.m.good@gmail.com
Institution Name:	Good Jeffrey M State
Code:	AZ
PE Codes:	5956

NSF Highlights: 2009

Tool Use in the Turkana Basin

Highlight ID: 18212, Version: AC/GPA

One of Dr. Braun's foremen (Benjamin Sila) excavating part of a bovid skeleton.

Credit: David Braun, University of Cape Town

Permission Granted

Dr. Braun is writing field notes next to the equipment on the excavation site.

Credit: David Braun, University of Cape Town

Permission Granted

The history of human evolution has been the subject of scientific inquiry for many years. Scientists have relied on archaeology (a field of science that studies historic and prehistoric peoples and their cultures through excavating and analyzing their remains, monuments, artifacts, and inscriptions) to aid them in understanding the timeline and the different developmental stages in human history.

Dr. David Braun, through an International Research Fellowship, worked on an excavation for artifacts of and remains of early hominins (humans), who made and used stone tools in the northern part of the Turkana Basin in Kenya. As a result of this fellowship, Dr. Braun found a very dense concentration of bones and artifacts that are nearly two million years old. Through the analysis of these remains and artifacts, Dr. Braun determined that early humans: lived in the Turkana Basin about two million years ago; manufactured and transported stone tools; and used a riparian forest as a focus for their activities.

Dr. Braun worked closely with experienced colleagues such as: Dr. Mzalendo Kbunjia (the main collaborator at the National Museums of Kenya, who hosted Dr. Braun's research project, provided the necessary facilities to store the specimens, and assisted in his analysis), and Dr. John Harris at Rutgers University, who has 30 years of experience in Turkana Basin. Additionally, Dr. Braun collaborated with several researchers at the University of Cape Town's Geology Department and Rutgers University. In collaboration with the Koobi Fora Research and Training Project, Dr. Braun conducted field trips for American, Kenyan, and South African students to the research sites. These field experiences positively influenced the students to the extent that some of them are now continuing their education, and working towards their degrees in archaeology.

Finally, Dr. Braun reached out to the local communities around the excavation sites and met with village elders, educating them about the cultural and scientific importance of the sites. Dr. Braun published articles in local newspapers in Cape Town (The Cape Times) to raise awareness of his research and its impact on the field of human evolution. He also published several articles in scholarly journals such as *Archaeological Science* and the *Journal of Human Evolution*.

Primary Strategic Outcome Goal:

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Postdoctoral Education and Fellowships

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: Transformative Research*
No

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)
No

What may be the benefits of the proposed activity to society?
Yes

In addition to increasing our knowledge in the field of archaeology, Dr. Braun forged strong collaborations with researchers from Kenya and South Africa.

What is the intellectual merit of this activity?
Dr. Braun's project provided new data on the behavior of early hominins. It developed a greater understanding of how and why early humans used stone tools and where they went to retreive stone to make tools. This is of vital importance to the study of evolution of human behavior because it shows that early humans that had a much more ape-like body form were already using stone tools to access meat and marrow. This is a major change from our last common ancestor with chimpanzees. This may suggest that stone artifacts were a major impetus behind the appearance of the modern human body form with long limbs and a larger brain.

What are the broader impacts of this activity? MeritReviewBroaderImpacts Criterion:RepresentativeActivities,July2007

This work has increased our knowledge in the field of archaeology, and as indicated above, has been shared broadly via publication of Dr. Braun's results.

In addition, Dr. Braun has done much to train future researchers and has assisted in their continuing education.

O/D/OISE 2009

NSF Award Numbers:
0602021

Award Title:	International Research Fellowship Program: Pliocene Technology: Hominin Adaption and Tool Use in the Turkana Basin
Start Date:	07/01/2006
Expires:	06/30/2007
Awarded Amount to Date:	$85,945
PI:	David Braun, drbraun76@gmail.com
Institution Name:	Braun David R
State Code:	NJ
PE Codes:	7316

NSF Highlights: 2008

Conservation and Management of African Elephants

Highlight ID: 15158, Version: AC/GPA

Photo of Dr. George Wittemyer, working on elephant conservation in East Africa.

Credit: Renee Kuriyan

Permission Granted

Dr. George Wittemyer was supported for 22 months by a fellowship under the International Research Fellowship Program (IRFP) at Makerere University in Kampala, Uganda and the University of Copenhagen in Denmark. Dr. Wittemeyer's research was conducted in East Africa.

Dr. Wittemyer's research addresses issues impacting the conservation and management of African elephants. With elephant populations increasing in some parts of Africa and declining in others, wildlife authorities face a range of conservation issues including human elephant conflict, ivory poaching, and increased confinement which amplifies the ecological role played by this species. These problems demand a multitude of solutions such as translocation, fencing and increased policing that can be more effectively implemented with science-based planning. Inspired by the difficulty of addressing these conservation concerns while securing the ecological requirements of this keystone species, Dr. Wittemyer's research uses genetic approaches to understand the factors influencing elephant population structure, movement and migration, and social interactions. His approach entails individual based research on a wild population of elephants in northern Kenya where he has identified over 700 elephants from ear patterns.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *ReporttoCongress:TransformativeResearch* *at theNationalScienceFoundation,April16,2008* *and* *ImportantNotice130:* *Transformative Research*

Yes

During the Fellowship, Dr. Wittemyer was trained and gained a depth of understanding in a new discipline in the biological sciences. This diversified his skills and advanced his ability to posit and address novel lines of research.

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

Yes

This project developed and strengthened institutional collaborations between US science institutions, both University of California, Berkeley and University of Utah, and African science institutions, in Kenya both the Kenya Wildlife Service and Save the Elephants, and in Uganda Makerere University.

What may be the benefits of the proposed activity to society?

Yes

The African elephant is a threatened species and is a poster child for conservation in Africa and Asia. As such, conservation and research activities on elephants are of great interest to the general public.

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
This project developed and strengthened institutional collaborations between US science institutions, both University of California, Berkeley and University of Utah, and African science institutions, in Kenya both the Kenya Wildlife Service and Save the Elephants, and in Uganda Makerere University. In addition, the scientific integrity of a long-term field project in Africa was strengthened through Dr. Wittemyer's research.

O/D/OISE 2008

NSF Award Numbers:
0502340

Award Title:	International Research Fellowship Program: Fine-Scaled Genetic Structure of a Free Ranging Elephant Population
Start Date:	01/01/2006
Expires:	10/31/2007
Awarded Amount to Date:	$157,965
PI:	George Wittemyer, G.Wittemyer@ColoState.edu
Institution Name:	Wittemyer George
State Code:	CA PE
Codes:	7316

Evolution of Australian Acacia Thrips

Highlight ID: 15182, Version: AC/GPA

Dr. Jeremy Bono was supported from October 2004 through October 2006, by a fellowship under the International Research Fellowship Program (IRFP). This research was conducted at Simon Fraser University, Burnaby, B.C., Canada. As a result of Dr. Bono's participation in the IRFP, he is currently a faculty member, PERT Postdoctoral Fellow, Center for Insect Science, Dept. of Ecology and Evolutionary Biology, with the University of Arizona.

The major objective of this research was to understand the genetic and ecological factors that promote the evolution of cooperative colony founding in one genus of Australian Acacia thrips (an insect from Australia). Progress toward this goal has been made in several ways. Two successful trips to Australia, where numerous collections of colony samples of four species that are central to the research were captured. These samples have been used for genetic analyses and also to discern some of the costs and benefits of cooperative colony founding for several species.

Dr. Jeremy M. Bono organized a research project to take the initiative to learn more about the Australian Acacia. It was found that, at least in one species, cooperations during colony founding occurs among related females, though sometimes unrelated females are involved. The research identified two benefits of cooperative colony founding: individual foundress survival is higher for foundresses in groups than for solitary foundresses and cooperative colony founding leads to larger colony size, which provides an advantage in interactions with kleptoparasitic thrips (stealing insects). Per capita reproduction declines with group size, indicating the possibility that some females in associations may behave altruistically by giving up reproduction.

At least one species in the genus is strictly solitary. This is valuable to know for future comparative work. Dr. Bono states that he has gained experience with a number of new research techniques and analyses. He also has learned to work with microsatellites and analyse these data for population genetics. With these new skills, he can apply them to any other research that is possible.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: Transformative Research*

Yes

The broad question that this research addresses is what factors promote the evolution of cooperation. This is a long-standing question in evolutionary biology, and we now know that diverse sets of conditions can promote the evolution of cooperation in different organisms. One of the hopes is that by examining this question in a diverse array of organisms we can identify general prinicples that underlie all forms of cooperation, be it in human, thrips, or social amoebae.

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

No

What may be the benefits of the proposed activity to society?

No

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
This work on cooperation in Australian Acacia thrips is significant because it greatly expands our comparative database for understanding factors that promote the evolution of cooperative nesting. To date, most of the detailed studies on this problem have been conducted with the Hymenoptera (an order of insects). Dr. Bono was able to secure a second postdoctoral fellowship funded partly based on his previous track record.

O/D/OISE 2008

NSF Award Numbers:
0402018

Award Title:	International Research Fellowship Program: Evolution of Pleometrosis in Phyllode-Gluing Acacia Thrips
Start Date:	10/01/2004
Expires:	10/31/2006
Awarded Amount to Date:	$110,586
PI:	Jeremy Bono, jbono@uccs.edu
Institution Name:	Bono Jeremy M
State Code:	CO
PE Codes:	7316

Long-Term Effects of the Developmental Environment on the Immune Response in Ring-Necked Pheasants (Phasianus Colchicus)

Highlight ID: 15325, Version: AC/GPA

Dr. Jennifer Grindstaff was supported from June 2004 through August 2006, by a fellowship under the International Research Fellowship Program (IRFP) at Lund University, Lund Sweden. Dr. Grindstaff is currently an Assistant Professor with the Department of Zoology at Oklahoma State University.

The primary objective of the project was to test the relative importance of the developmental environment, current condition, and MHC genotype on immune responses and parasite reisitance. The team initially proposed to conduct this research on a captive population of ring-necked pheasants (Phasianus colchicus). Ultimately, they conducted these studies on both pheasants and in a natural population of European starlings (Sturnus vulgaris).

Dr. Grindstaff's research interests incorporated concepts and approaches from physiology, behavioral ecology and evolutionary biology. This integrative approach is a powerful way to understand both the proximate mechanisms and evolutionary consequences of parental investments in determining offspring performance. For example, although there is a wealth of knowledge on the proximate mechanisms of maternal antibody transmission, relatively little is known about individual differences within a species in maternal antibody transmission or differences among species in transmission. Conversely, maternal effects theory has historically neglected the mechanistic basis through which mothers influence offspring phenotype. One goal of her research is to explain differences among individuals and species in maternal provisioning by integrating the proxminate mechanisms of transmission with evolutionary theory on maternal effects.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: Transformative Research*

No

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

No

What may be the benefits of the proposed activity to society?

Yes

This research will provide critical information about the role of the developmental environment in adult phenotypic expression, especially the immune response.

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
The primary objective of the project was to test the relative importance of the developmental environment, current condition, and MHC genotype on immune responses and parasite reisitance. The team initially proposed to conduct this research on a captive population of ring-necked pheasants (Phasianus colchicus). Ultimately, they conducted these studies on both pheasants and in a natural population of European starlings (Sturnus vulgaris). While Dr. Grindstaff was a postdoctoral fellow at Lund University, she also collaborated on two side projects. The research funds for the side projects were not obtained from NSF, however, if it were not for the IRFP, she would not have been a participant in these collaborations. Her participation as a postdoctoral fellow at Lund University. afforded her these additional opportunities. The objective of the projects were to determine if maternal immunization influences provisioning of eggs, offspring growth, and immune responses.

O/D/OISE 2008

NSF Award Numbers:
0404762

Award Title:	International Research Fellowship Program: Long-Term Effects of the Developmental Environment on the Immune Response in Ring-Necked Pheasants (Phasianus Colchicus)
Start Date:	06/15/2004
Expires:	08/31/2006
Awarded Amount to Date:	$152,871
PI:	Jennifer Grindstaff,jgrindst@indiana.edu
Institution Name:	Grindstaff Jennifer L
State Code:	IN
PE Codes:	7316

Sensory Integration and the Evolution of Multimodal Communication in Jumping Spiders

Highlight ID: 15331, Version: AC/GPA

Dr. Damian O. Elias was supported from September 2005 through June 2007 by a fellowship under the International Research Fellowship Program (IRFP). This fellowship has given Dr. Elias the experience and achievements necessary to accept a tenure-faculty appointment at a top level research institution, the University of California, Berkeley

Jumping spiders have been extensively studied in the context of visual communication. They possess an unusually large pair of frontal eyes that confer a degree of spatio-visual acuity far above any other spider or insect. These visual specializations are associated with a complex repertoire of visual behaviors including prey capture, courtship, and agonistic displays. His research has demonstrated that surprisingly, in one extremely diverse genus in jumping spiders, males use complex multicomponent seismic (vibratory) signals coordinated with its visual signals. This discovery and more importantly the implications of this discovery are wide reaching. First of all, this research has implications into the study of diversity and the mechanisms leading to species evolution. Jumping spiders as a family are one of the most diverse animals in the world and the genus that he is working on, /Habronattus/, is one of the diverse genera in this family. His recent work has focused on understanding the mechanisms driving species evolution in the genus and in particular the role of sensory integration and multimodal communication. He has collected and examined over 50 species in the genus and using techniques from molecular, computational and evolutionary biology, he is in the process of studying patterns driving this extraordinary diversification. One of the most striking preliminary results from this study is that it appears that complexity between visual and vibratory signals are positively linked and that coordination of complex multimodal signals is associated with increases in species diversity. This link between sensory processing and species evolution will be an important contribution to worldwide research dealing with neurobiology, behavior, and evolution.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: Transformative Research*

No

How well does the proposed activity broaden the participation of underrepresentedgroups (e.g., gender, ethnicity, disability, geographic, etc?)

Yes

Dr. Elias's work stemming from this project has provided opportunities for research and teaching in science, including people in underrepresented groups, and provided exposure to non-scientist members of the public. First of all, he endeavoured to include undergraduates in all aspects of his work. Many of these undergraduates were from underrepresented groups (including groups of African, Latino, and Middle Eastern descent). He attempted to involve undergraduates at all levels of scientific endeavor including experimental design, conducting experiments, and analyzing data.

What may be the benefits of the proposed activity to society?

Yes

Through these efforts Dr. Elias has continued to be involved with the scientific community and the general public through the lay media and outreach programs.

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
International experiences for Graduate and Undergraduate students.

O/D/OISE 2008

NSF Award Numbers:
0502239

Award Title:	International Research Fellowship Program: Sensory Integration and the Evolution of Multimodal Communication in Jumping Spiders
Start Date:	09/01/2005
Expires:	12/31/2007
Awarded Amount to Date:	$136,139
PI:	Damian Elias, doe2@cornell.edu
Institution Name:	Elias Damian O
State Code:	NY
PE Codes:	7316

Tropical Forest Songbird Behavior and Movements in Human-Dominated Landscapes

Highlight ID: 15562, Version: AC/GPA

cocoa woodcreeper with radiotag shown

Credit: Dr. John Withey

Permission Granted

Dr. Withey listens to the radio signals from one of the radiotagged individuals.

Credit: Dr. John Withey

Permission Granted

Dr. John Withey was supported for 15 months in 2007-2008 at the Smithsonian Tropical Research Institute (STRI) in Panama by a fellowship from the International Research Fellowship Program (IRFP), with funds from the Office of International Science and Engineering (OISE) Americas Program. Working with his host, Dr. Bill Laurance, his project was to study tropical forest songbird behavior and movements. He wanted to understand how the types of land use affect a bird's movement and behavior. Results of this work will provide conservation planners with critical information about the species that are expected to persist in highly fragmented, human dominated landscapes, and what types of land uses are compatible with providing habitats to birds.

In Panama, forest has regrown in much of the former Canal Zone, even as human developments continue to spread. The lands surrounding these forests are used for different purposes, such as roads, buildings, housing developments, pasture, and agriculture. Dr. Withey tested how birds use both forested and non-forested lands, and how the type of land use affects the birds' movement and behavior. Understanding this topic is extremely important in planning for the protection of tropical bird species that use forested habitats. While large land reserves such as national parks will always be important to birds, tropical forests are being cut down at a rapid pace. As human populations grow, there will be more and more human-dominated landscapes in the world. Dr. Withey's research showed how birds use such lands, and how we may better plan land use to provide habitat for birds that depend on forests.

Dr. Withey's approach was to capture, radiotag and release individual birds from three focal species: the dusky antbird, red-throated ant

Male red-throated ant tanager held for banding. Credit: Dr. John Withey

Permission Granted

tanager, and cocoa woodcreeper. The three species are different sizes and from different bird families, and are all relatively common in the forests of central Panama. Dr. Withey captured the birds in areas with both forested and non-forested habitat, as well as a variety of edge types.' For example, in these landscapes forest patches may be adjacent to a road, or buildings, or stands of Canal grass (a tall, invasive non-native species), or have natural gaps (forest openings) that create edges of forest with more-open habitat.

Once a bird was radiotagged, Dr. Withey and his assistants tracked the bird's movements and recorded behavior and habitat types during 1-hour observation periods. Using GIS software tocompile land cover and land use data, they compared relocations of each individual bird with the habitat and surrounding landscape. The resulting data was then analyzed to determine if each species has particular habitat preferences, if their behavior or movement rates are different in different habitats or edge types, and how large a gap or forest opening the birds will cross.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: TransformativeResearch*

No

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

No

What may be the benefits of the proposed activity to society?

Yes

This fellowship gave a young U.S. researcher deeper insight and knowledge in this important area of research. When Dr. Withey returns to the U.S. and to academia, he will share that new knowledge in his work with students, in collaborating with other researchers in the field, and in outreach to the scientific community. In addition, results from his research will provide conservation planners with critical information about the species expected to persist in highly fragmented, human-dominated landscapes, and what types of land uses are compatible with providing habitat to birds.

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?

Dr. Withey will publish results of his research in peer-reviewed journals and present his findings at international conferences. He will also make presentations to Panamanian staff at the national parks in which he worked, as well as local conservation groups such as the Panama Audubon Society. He has benefited professionally from the connections made at STRI and has already submitted a research proposal to work on the effects of landscape change on bird communities in North America. He has also taken advantage of teaching and training opportunities in Panama by teaching a class on the principles of radiotelemetry for Panamanian college students. In addition to research experience, the IRFP provided Dr. Withey with invaluable experience in managing his own research budget and hiring and supervising assistants in a cross-cultural setting.

O/D/OISE 2008

NSF Award Numbers:
0602091

Award Title:	International Research Fellowship Program: Tropical Forest Songbird Behavior and Movements in Human-Dominated Landscapes
Start Date:	01/01/2007
Expires:	07/31/2008
Awarded Amount to Date:	$86,842
PI:	John Withey, jwithey@u.washington.edu
Institution Name:	Withey John C
State Code:	WA
PE Codes:	7316, 5956

NMR Studies of Protein Folding: An Evolutionary Perspective

Highlight ID: 15659, Version: AC/GPA

Dr. Lesley H. Greene was supported from May 2000 through April 2003, by a fellowship under the International Research Fellowship Program (IRFP). Dr. Greene's research was conducted at the University of Oxford, considered to be one of the world's leading academic institutions. This research involved using nuclear magnetic resonance (NMR) to study the process of protein folding at atomic resolution.

Along with her host collaborator, Dr. Christina Redfield, developed a novel way to view and study protein structures which challenges the traditional and thirty year old view. This fellowship also enabled her to learn advanced techniques to test ideas about protein folding which she first imagined as an undergraduate, developed as a graduate student and significantly advanced as a post-doctoral fellow at Oxford. Today as an Assistant Professor in the U.S.A., Dr. Greene is working with a multi-disciplinary group from the biological, physical, mathematical and computer sciences as well as her English collaborators in a continuation of this work. Together they aim to resolve the protein folding problem also known as the second-half of the genetic code which remains one of the most significant intellectual challenges in science today. This work has implications for research being done on many diseases such as Alzheimers, Parkinsons and Type II diabetes in understanding the mechanism of amyloid fibril formation.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals:

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see ReporttoCongress:TransformativeResearch at theNationalScienceFoundation,April16,2008 and ImportantNotice130: TransformativeResearch*

Yes

In order to understand the determinant of a proteins topology, Dr. Greene in collaboration, modelled protein structures as network systems. This led to a novel way to view protein structures and a publication in the Journal of Molecular Biology (Greene and Higman, 2003). It also laid the foundations for a new methodology to rigorously analyze protein folds. During the course of this work, Dr. Greene also identified a group of proteins which share a common Greek-key topology but differ in secondary structure, sequence and function. Subsequent work following the fellowship period resulted in the identification of a conserved network which she believes is a key determinant of folding. Her results are published in Physics A (Higman and Greene, 2006).

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

Yes

Dr. Greene's scientific training and education at the University of Oxford has made her a better scientist, teacher and research mentor. This aids our countries' efforts to produce capable scientists here in the U.S.A. and better instruct our undergraduates in science, particularly biochemistry. Dr. Greene maintains that her past, present and future success will inspire more women to seek professions in the physical sciences in which they are underrepresented.

What may be the benefits of the proposed activity to society?

Yes

One new avenue of research Dr. Greene is undertaking today seeks to identify the mechanism of amyloid fibril formation which underlies many diseases such as Alzheimers, Parkinsons and Type II diabetes. Her prior training during the fellowship period has well prepared her for this work. It is her hope that she will be able to significantly contribute to the prevention and treatment of these diseases which will help improve the health of the American people as well as the world community.

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
Dr. Greene's work provides important insights which further the boundaries of our knowledge of the protein folding process. Her results also offer a new perspective in which to view and study protein structures which can stimulate the development of new theoretical and experimental approaches to advance a wide range of research efforts in the U.S. community.

O/D/OISE 2008

NSF Award Numbers:
0000597

Award Title:	International Research Fellow Awards: NMR Studies of Protein Folding: An Evolutionary Perspective
Start Date:	05/01/2000
Expires:	04/30/2003
Awarded Amount to Date:	$120,756
PI:	Lesley Greene, lesley@bioch.ox.ac.uk
Institution Name:	Greene, Lesley H
State Code:	
PE Codes:	5956

Conservation and Management of African Elephants

Highlight ID: 16715, Version: AC/GPA

George Wittemyer bolting a collar on an elephant.

Credit: George Wittemyer

The African elephant is a threatened species and a poster child for conservation in Africa and Asia. In light of this situation, Dr. George Wittemyer used his grant under the International Research Fellowship Program (IRFP) to study the elephant population of Uganda, in collaboration with Dr. Silvester Nyakaana, Makerere University in Uganda, and with Dr. Hans Siegismund at Copenhagen University in Denmark. Based on genetic analyses, it was discovered that elephants form complex, hierarchical social organizations called nodes. For example, the older, dominant matriarchs are considered to be in a "grandparent" node. Though the elephants form these groups, there is often genetic mixing, as males cross from other groups to mate. It is important to protect the grandparent nodes in the social network, in order to ensure the integrity of the elephant population properties. These older members of the group are often targeted for ivory harvesting. Dr. Wittemyer found that there was rapid decline over periods of time caused by heavy poaching. By being able to track these various groups, this research helps people who work in conservation and wildlife management. By using these genetic approaches, they can understand the factors influencing the elephant population structure, movement and migration, and social interaction. The elephant populations are being conserved by relocating them, using fencing to direct their movements, and by increased policing.

Primary Strategic Outcome Goal:

- Postdoctoral Education and Fellowships

Secondary Strategic Outcome Goals: Discovery

- International

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *ReporttoCongress:TransformativeResearch* *at theNationalScienceFoundation,April16,2008* *and* *ImportantNotice130:* *Transformative Research*

No

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

No

What may be the benefits of the proposed activity to society?

No

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?

This fellowship allowed a young U.S. scientist to develop skills in a novel discipline. Because of this, he will expand the types and directions of research he and his students will carry out during his academic career. Specifically, he was trained in laboratory and analytical procedures in the field of population genetics. He has been awarded an adjunct professor position at Portland State University.

O/D/OISE 2008

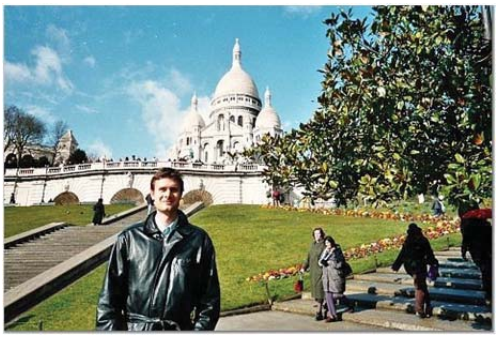
NSF Award Numbers:
0502340

Award Title:	International Research Fellowship Program: Fine-Scaled Genetic Structure of a Free Ranging Elephant Population
Start Date:	01/01/2006
Expires:	10/31/2007
Awarded Amount to Date:	$157,965
PI:	George Wittemyer, G.Wittemyer@ColoState.edu
Institution Name:	Wittemyer George
State Code:	CA PE
Codes:	7316

NSF Highlights: 2007

Investigating the role of neural networks in mammalian working memory

Highlight ID: 13293, Version: AC/GPA



Dr. Alexander Roxin in front of the Sacre Coeur Basilica in Paris, France.

Credit: Alexander Roxin

Permission Granted

Working memory -- the ability to hold information for just long enough to complete a related task -- is evidenced in the brain of live monkeys by an elevated firing rate of some neurons in the pre-frontal cortex (PFC). One of the great unknowns in the cerebral cortex, however, is the actual distribution of functional synaptic connections and the role that various distributions might play. A greater understanding of these circuits in the PFC is necessary for understanding mechanisms underlying "intelligent" behavior in addition to several serious disorders, including Schizophrenia and Parkinson's disease.

Dr. Alexander Roxin was supported for 24 months by a fellowship under the International Research Fellowship Program (IRFP) at the University Rene Descartes in Paris, France to investigate the role of different synaptic distributions in a model of working memory by means of analytical and numerical methods. The IRFP is designed to provide young U.S. postdoctoral scientists and engineers with opportunities for joint research and the use of unique or complementary facilities, expertise and experimental conditions abroad. Dr. Roxin's work was carried out at the Centre Nationale de la Recherche Scientifique (CNRS) Neurophysics and Physiology with his host Nicolas Brunel, a leading researcher in the field, and a handful of other collaborators.

Dr. Roxin completed a systematic characterization of the emerging activity in a network of spiking neurons as a function of excitatory and inhibitory connections in the PFC. The work of Dr. Roxin and his collaborators has led to multiple conference poster presentations, invited lectures, and publications. The results published by the
PI and his collaborators represent a large step forward in understanding the emergent activity in networks of large numbers of spiking neurons, and ultimately provide a necessary step in beginning to understand the neural correlate of intelligent animal behavior. Continued collaboration and future publications are expected from Dr. Roxin and his colleagues at the CNRS.

Primary Strategic Outcome Goal:

- Discovery: Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.

Secondary Strategic Outcome Goals: Learning

- Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

Does this highlight represent transformative research?
No

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?
This award gave an opportunity to a postdoctoral researcher to foster research that will advance the frontiers of knowledge, as stated in the "Discovery" strategic outcome goal.

O/D/OISE 2007

NSF Award Numbers:
0302085

Award Title:	International Research Fellowship Program: How Patterns of Synaptic Connectivity Affect Network Activity in a Model of Mammalian Pre-Frontal Cortex
Start Date:	09/15/2003
Expires:	08/31/2005
Awarded Amount to Date:	$134,900
PI:	Alexander Roxin, a-roxin@northwestern.edu
Institution Name:	Roxin, Alexander C State
Code:	IL
PE Codes:	1253

NSF Highlights: 2007

Duetting in the New Zealand Kokako

Highlight ID: 13295, Version: AC/GPA

Dr. Laura Molles and New Zealand's endangered kokako.

Credit: Dr. Laura Molles

When Dr. Laura Molles began investigating the bird song of New Zealand's endangered, endemic kokako, she never imagined her research would lead directly to a unique conservation application. Most of us think of bird song as something males perform to woo prospective mates; in northern temperate regions of the world, including the United States, this stereotype tends to hold true. In many tropical and southern hemisphere species however, such as the kokako, male and female partners sing in striking coordination.

An NSF International Research Fellowship allowed Dr. Molles to investigate the structure and functions of this style of singing, called duetting, in collaboration with Dr. Joe Waas at the University of Waikato in New Zealand. Their research suggested that kokako duets are, at least in part, a cooperative effort on the part of mated pairs that likely serves a variety of communicative functions, including the defense of large, year-round territories and pair bonds. Kokako duets, besides being extremely beautiful, are incredibly complex and unlike any other described bird song. A typical kokako duet lasts 30 to 45 seconds and unfolds slowly, with lengthy but carefully measured pauses. Males and females *tend* to sing particular portions of the song, but some pairs are able to swap singing roles from song to song without a loss of coordination.

Dr. Molles performed a series of playback experiments designed to discover what it is about these duets that makes them more effective territorial signals than solo songs. Her results showed that kokako differentiate strongly between one and two sources of sound, and suggested that they may be capable of discriminating female from male singers despite the great flexibility in male and female contributions. Her "pure science" investigation of kokako song furthermore led directly to a unique conservation application: the use of song playback as an "anchor" for kokako during reintroduction to restored habitats. This application has proven to be an exciting and very rewarding marriage of behavioral ecology and conservation.

In addition to allowing Dr. Molles to undertake a challenging project of her own design, the NSF fellowship gave her the opportunity expose other U.S. students and scientists to New Zealand's successful model of combining pure and applied science. During her fellowship Dr. Molles employed two field assistants from the United States

and helped teach an undergraduate course in conservation biology for a University of Wisconsin study abroad program.

Due in part to the strength of her research program that combined original, question-driven science with real-world conservation, Dr. Molles obtained a faculty position as a lecturer at New Zealand's Lincoln University. She teaches courses in ecology and conservation, and is supervising graduate students working with penguins, parrots and songbirds. The collaborations established during her fellowship – not only with her host scientist and institution, but also with the Department of Conservation and other research institutions in New Zealand – continue to benefit her career as she expands her kokako research and moves on to new projects.

Primary Strategic Outcome Goal:

- Discovery: Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.

Secondary Strategic Outcome Goals: Learning

- Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

Does this highlight represent transformative research?

No

How does this highlight address the strategic outcome goal(s) as described in the NSFStrategicPlan2006-2011?

This award gave an opportunity to a postdoctoral researcher to foster research that will advance the frontiers of knowledge, as stated in the "Discovery" strategic outcome goal.

O/D/OISE 2007

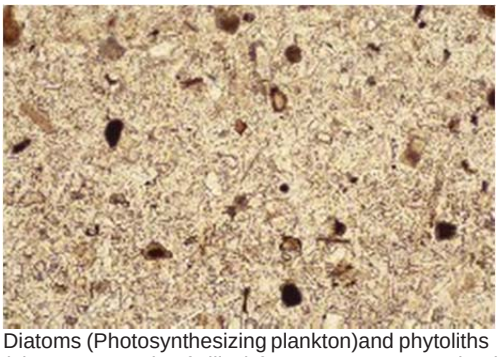
NSF Award Numbers:
0107347

Award Title:	International Research Fellowship Program: Study of Duetting in the New Zealand Kokako
Start Date:	09/01/2001
Expires:	08/31/2004
Awarded Amount to Date:	$80,350
PI:	Laura Molles, mollesl@lincoln.ac.nz
Institution Name:	Molles, Laura E
State Code:	VA
PE Codes:	5956

NSF Highlights: 2006

East African Paleoclimate from Ancient Lake Clays: Linking Ecosystem Change with Hominid Evolution

Highlight ID: 11302, Version: AC/GPA



Diatoms (Photosynthesizing plankton)and phytoliths (plant parts made of silica) from Ngorongoro wetland sediments. In some circumstances, the silica in these biological compoments interacts with saline waters to form clay minerals that can reveal information on the chemistry of the waters in which they form.

Credit: Daniel M. Deocampo

Permission Granted

View across Olduvai Gorge, Tanzania, at the 3rd Fault. The layer-cake stratigraphy is valuable for regional paleoenvironmental reconstruction, and reconstructing environmental change in this paleo-lake basin over the past couple million years.

Credit: Daniel M. Deocampo

Permission Granted

Dr. Daniel Deocampo was supported for 13 months by a fellowship under the International Research Fellowship Program (IRFP) to study at the Department of Mineralogy at the Natural History Museum in London, United Kingdom. The IRFP is designed to launch young U.S. postdoctoral scientists and engineers into becoming globally-engaged.

The main purpose of his project was to continue to develop the technique of reconstructing ancient climate changes through analyzing the chemistry of nano-scale clay minerals that formed from ancient lake waters. This project has been field-intensive, with work carried out in several lake basins of northern Tanzania and Kenya, including several that are important to our understanding of human evolution. A detailed reconstruction was made for the paleo-lake at Olduvai Gorge, Tanzania, and provided a record of environmental fluctuations around 1.8 million years ago in East Africa, that has provided a basis for understanding interactions between environmental change at that time, human evolution, and the rise of technology among our ancestors.

Understanding modern environments has been an important part of reconstructing the past, and Deocampo's related work has produced new understandings in environmental chemistry. This has contributed to the scientific basis needed in sub-Saharan Africa for balancing the competing needs of indigenous communities, wildlife, and economic development, in sensitive environments such as the Ngorongoro Crater, Tanzania, a World Heritage Site. This research focus has led Deocampo to a new effort to use similar approaches in studying lake sediment in western North America, such as in the Barstow Basin,

Ngorongoro Crater, Tanzania, where studies of the modern environment can not only be used for environmental protection, but also to help understand sedimentary and geochemical records of similar ancient environments.

Credit: Daniel M. Deocampo

Permission Granted

The active volcano Oldoinyo Lengai, as viewed from near the top of the East African Rift escarpment. Ash from volcanoes such as this affect the chemistry of water and sediment throughout the region, and provide datable time-marker horizons in lake sediment.

Credit: Daniel M. Deocampo

Permission Granted

Deocampo with Masaai guides and Richard Hay, geologist for Mary Leakey during the 60's and 70's at Olduvai Gorge.

Credit: Daniel M. Deocampo

Permission Granted

California, and the Great Basin lakes such as Mono, Pyramid, and Walker Lakes.

This line of research has also led to new areas of research on formation of clays and other minerals in modern landscapes. Deocampo is now studying the development of soils in the Coast Range of northern California, and how it impacts the origin and fate of mercury, a major environmental hazard in the region. He is also studying the mineralogical forms and geochemical behavior of lead in urban Sacramento, using his interdisciplinary background and international collaborations to find solutions to contemporary American environmental problems.

In all this work, the international collaborative relationships Deocampo formed in London, and elsewhere in Europe while on fellowship there, have been critical in his professional development and scientific progress. The mineralogical techniques he was exposed to in London are state-of-the-art, and he brings those experiences and perspectives to his new studies in the U.S. He maintains an active collaborative relationship with Dr. Javier Cuadros, of the Natural History Museum, who is an expert on the detailed crystal structure of clays and other minerals. Cuadros visited Deocampo in Sacramento during June, 2005, to continue their collaborative work on a project representing a significant advance in understanding the chemistry of these minerals, and how they interact with lake and soil waters. In this effort, Deocampo is leading the team of British, Spanish, and Polish scientists, and they plan to submit a joint manuscript reporting these results in the coming months. As a result of their meeting, Cuadros has agreed to continue collaborating, to bring his expertise to

Deocampo's new studies of mercury interaction with minerals in streams and soils of northern California.

Primary Goal Indicators:

- Collaborations

Secondary Goal Indicators:

Other Indicators (Is this work transformative or multidisciplinary?):

This work involves multidisciplinary research.

This project involves chemistry and geology, as well as increasing our understanding of human evolution and the rise of technology.

This work is notable because

This international research experience made Dr. Deocampo more marketable in his search for a tenure track position. In addition, he has continued his collaboration with his foreign host, which has allowed his research to expand and flourish.

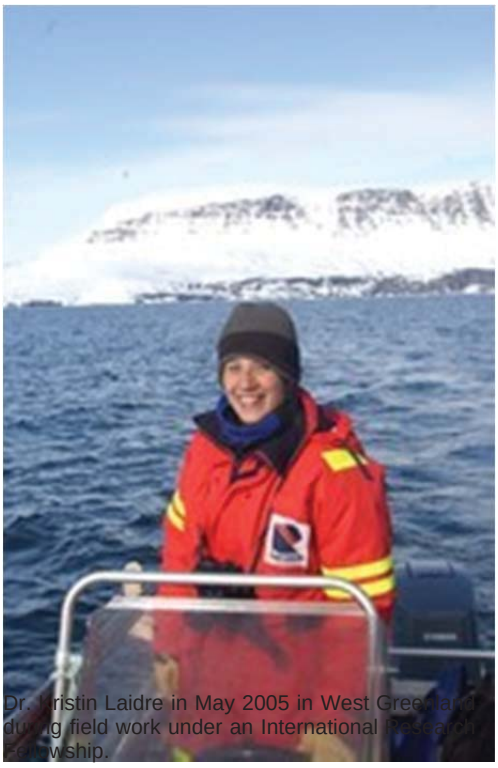
O/D/OISE 2006

NSF Award Numbers:
0202612

Award Title:	International Research Fellowship Program: East African Paleoclimate from Ancient Lake Clays: Linking Ecosystem Change with Hominid Evolution
Start Date:	10/01/2002
Expires:	10/31/2003
Awarded Amount to Date:	$81,990
PI:	Daniel Deocampo, deocampo@gsu.edu
Institution Name:	Deocampo Daniel M
State Code:	DC
PE Codes:	5956

Arctic Cetaceans: Indicators of Climate Change

Highlight ID: 12092, Version: AC/GPA



Dr. Kristin Laidre in May 2005 in West Greenland during field work under an International Research Fellowship.

Credit: Dr. Kristin Laidre

Permission Granted

A bowhead whale in Disko Bay, West Greenland. This is one of the three Arctic whale species that occupies habitat above the Arctic circle and is highly vulnerable to climate change.

Credit: Dr. Kristin Laidre

Permission Granted

Dr. Kristin Laidre was supported for 22 months by a fellowship under the International Research Fellowship Program (IRFP) at the Greenland Institute of Natural Resources in Nuuk, Greenland. The IRFP is designed to launch young U.S. postdoctoral scientists and engineers into becoming globally-engaged.

Dr. Laidre's research addresses questions concerning the vulnerability of arctic cetaceans to climate change. The Arctic is currently experiencing dramatic changes in sea ice characteristics and marine productivity, which will have cascading effects on Arctic food webs. Three species of cetaceans (the narwhal, beluga, and bowhead whale) inhabit arctic waters of West Greenland and are ideal indicator organisms for monitoring ongoing biophysical changes impacted by a warming climate. Arctic cetaceans' seasonal movements, distribution, resource selection, and life history parameters are tightly linked with changes in the arctic environment, making them both vulnerable to climate alterations and good indicators of cumulative changes.

The main purpose of the project has been to contrast arctic species inhabiting different ecological niches with different life history strategies to support broader inferences regarding the effects of climate changes in different habitats of the high Arctic. Dr. Laidre has quantified the trends in sea ice and primary production in focal areas using satellite telemetry data on whale movements and diving behavior and remotely-sensed environmental data. This information has been used to examine resource selection and differential vulnerability based on quantitative spatial modeling techniques. Results of this work

have facilitated the understanding of the potential effects of climate change on high arctic top predators and the sustainability of their exploitation by Inuit communities, linking scientific discovery to societal benefit.

The host institute, the Greenland Institute of Natural Resources (GINR) in Nuuk, Greenland, is the Greenland Home Rule Government's center for nature research focusing on conservation, climate change and human impacts, biological diversity, and sustainable use of living resources. Dr. Laidre's research has been in collaboration with senior scientist Dr. Mads Peter Heide-Jørgensen at GINR.

In addition to several peer reviewed scientific manuscripts and a popular book published during the fellowship, Dr. Laidre's research has extended into an international review paper together with several top arctic ecologists developing a quantitative index to rank the vulnerability of arctic marine mammals to climate change. In all this work, the international collaborative relationships Dr. Laidre formed in Denmark/Greenland, and elsewhere in Europe while on fellowship there, have been critical in her professional development and scientific progress. Her work has elucidated broad cetacean resource selection relationships and documented biocomplexity associated with changing climate.

Primary Goal Indicators:

- Global S&E workforce

Secondary Goal Indicators:

- Collaborations

Other Indicators (Is this work transformative or multidisciplinary?):

This work involves multidisciplinary research.
This research is of importance those working on issues of climate change as well as to biologists who study diversity and conservation.

This work is notable because
This award provided a young U.S. researcher with a unique opportunity to work in Greenland with top arctic ecologists. She has already published results and has formed relationships that will be important throughout her career.

O/D/OISE 2006

NSF Award Numbers:
0401077

Award Title:	International Research Fellowship Program: Arctic Cetacean Phenology, Biogeography, and Impacts of Climate Change
Start Date:	10/15/2004
Expires:	11/30/2006
Awarded Amount to Date:	$108,548
PI:	Kristin Laidre, klaidre@apl.washington.edu
Institution Name:	Laidre Kristin L
State Code:	WA PE
Codes:	7316

NSF Highlights: 2005

Algal Biodiversity and Landscape Patterns in Tropical Streams

Highlight ID: 10885, Version: AC/GPA

Arboleda stream, La Selva Biological Station

Credit: Dr. Rebecca Bixby

In the neotropics, where diversity of larger organisms is not well understood, even less is known about the microscopic organisms inhabiting the rainforests. Diatoms, a group of microscopic algae, are an important part of the "primary producer" community in streams and rivers in these forests. Species of diatoms often live within narrow environmental conditions, making them important indicators of the aquatic and terrestrial environments, e.g., light, nutrient levels, and salinity. Understanding the diversity and role of diatoms in streams is important to comprehending how rapid deforestation in the neotropics is affecting associated stream ecosystems.

Dr. Rebecca J. Bixby, supported under the International Research Fellowship Program (IRFP), has studied the biodiversity and landscape patterns of diatoms in lowland neotropical streams. These streams are located at La Selva Biological Station, in the lowlands of Costa Ricas northern Caribbean slope. Dr. Bixby, in collaboration with Costa Rican and American scientists and students, has collected over 800 diatom samples from these rainforest streams over a two-year period.

Dr. Bixby estimates that nearly 30% of the species collected are new to science and that many more have been described only from the neotropics. One notable example is the discovery of a new diatom species which is dominant in high-solute streams. Seminavis silvatropicalis sp. nov. is the first freshwater species described in a genus which formerly only contained marine and estuarine species (Bixby and Wydrzycka, submitted). Since the transition from a marine to freshwater habitat (or vice versa) is considered a major evolutionary step, the discovery of this freshwater diatom is an interesting find.

In addition to illuminating the biodiversity of rainforest diatoms, these collections have been used to show relationships between species community changes and chemical/physical parameters. Distinct shifts in species composition in response to solute, light, and pH levels have been observed. This information can be used in environmental monitoring, giving a clear indication of ecosystem health.

Primary Goal Indicators:

- Global S&E workforce

Secondary Goal Indicators:

- Collaborations

Other Indicators (Is this work transformative or multidisciplinary?):

No other indicators apply.

This work is notable because
This fellowship allowed a young, female researcher to work outside of the United States at a notable research site in Costa Rica where a large number of international researchers are stationed. The fellowship gave her the opportunity to establish herself in an exciting field, allowing her to collaborate and forge relationships with internationally-respected biologists from other countries.

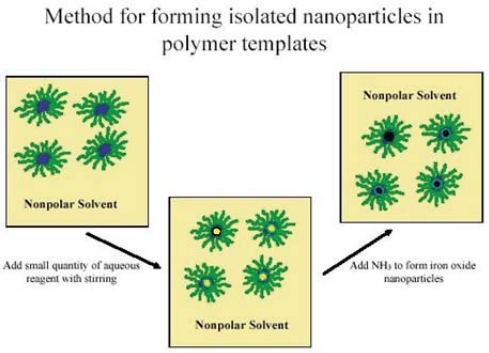
O/D/OISE 2005

NSF Award Numbers:
0202673

Award Title:	International Research Fellowship Program: Algal Biodiversity and Landscape Patterns in Tropical Streams
Start Date:	08/01/2002
Expires:	12/31/2004
Awarded Amount to Date:	$58,080
PI:	Rebecca Bixby, bbixby@unm.edu
Institution Name:	Bixby Rebecca J
State Code:	GA
PE Codes:	5977

Synthesis of Novel Magnetic Nanoparticles

Highlight ID: 9354, Version: AC/GPA



These two images illustrate the method to form well-defined iron oxide nanoparticles inside of reverse micelle (nanoreactors) polymer templates. The diblock copolymer is poly(butyleneoxide)-b-poly(ethylene oxide) and was synthesized by living anionic polymerization.

Permission Granted

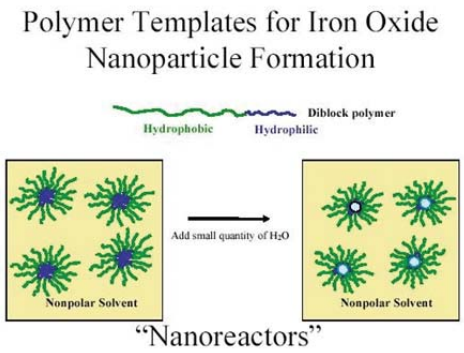


Image 2.

Permission Granted

Most current anticancer treatments destroy cancer cells by stopping them from growing or multiplying. In the process, healthy cells can be harmed and cause damaging side effects to cancer patients. Dr. Linda Harris, a synthetic polymer chemist from Virginia Tech and recipient of a prestigious NSF International Research Fellowship Program (IRFP) award, is working with world-renowned scientists at the University of Western Australia to provide doctors and patients with a better alternative that could use advanced nanoparticles to deliver drugs directly to a cancerous tumor without harming other parts of the body. Their research is an interdisciplinary collaboration to specially prepare optimized iron oxide nanoparticles. Without preventive measures, high surface energies observed in nanoparticles leads to aggregation and precipitation from solution. One common method to prevent this adverse effect is to coat the materials with polymer surfactants after they are prepared. However, characterization of these solutions often indicates that some aggregation is still observed. Harris aims to prepare polymers that are capable of forming spherical micellar structures in solution. The formation of the iron oxide nanoparticle inside the polymer template will prevent interaction of the particles which leads to aggregation and thus create well defined isolated nanoparticles. These advanced nanoparticles have potential electronic and biomedical applications such as magnetic field directed drug delivery, magnetic separations, and magnetic resonance imagining (MRI) contrast agents. This development of magnetic particles allows drugs to be guided through the body to target specific disease sites. Toxic drugs placed in an ampoule or enclosed capsule could go directly to a cancerous tumor and destroy cancer cells without harming other parts of the body. The ampoule would then pass out of the body after delivering the drug.

Primary Goal Indicators:

- Collaborations

Secondary Goal Indicators:

- Global S&E workforce

Other Indicators (Is this work transformative or multidisciplinary?):

No other indicators apply.

This work is notable because
This international research experience gives Dr. Harris the opportunity to work with physicist Tim St Pierre and other researchers in Australia. Each side contributes their unique expertise and experience to the project. Dr. Harris brings experience in polymers; her colleagues at the University of Western Australia, biomagnetics. St Pierre works in the field of the structure and magnetism of nanoscale iron oxides, particularly those found in biological systems. His most significant contributions lie in his multidisciplinary approach, which has enabled an unprecedented systematic investigation into the relationships between structure and magnetic properties of oxide nanoparticles.

O/D/OISE 2005

NSF Award Numbers:
0207035

Award Title:	International Research Fellowship Program: Synthesis of Novel Magnetic Nanoparticles Engineered with Polymeric Micellar Templates
Start Date:	06/01/2002
Expires:	03/31/2005
Awarded Amount to Date:	$123,872
PI:	Linda Shekhawat, lindas@polychemistry.com
Institution Name:	Harris Linda A
State Code:	VA
PE Codes:	1253

Bone Strength and Fracture Healing

Highlight ID: 9355, Version: AC/GPA

Dr. Sandra J. Shefelbine was awarded an International Research Fellowship to go to Ulm, Germany to work with Dr. Lutz Claes at the University of Ulm's Institute of Orthopaedic Research and Biomechanics. This institute is one of the leading centers world-wide for research on fracture healing. Their research in Ulm focuses particularly on the influence of mechanical loads on fracture healing and the mechanical properties of the bone fracture as it heals. The institute provides a unique interdisciplinary atmosphere as doctors, veterinarians, physicists, cell biologists, and engineers work together on a single project.

This combination of disciplines creates an excellent environment to develop new techniques and methods. This particular research project focused on combining imaging and computer modelling techniques in order to determine how well a fracture is healing. Such a method could be a useful tool for doctors to determine how much longer a fractured bone must be stabilized, if additional stabilization is needed, or what the effects of new treatments are on the healing process.

Fracture healing studies examine the effects of surgical procedures, drugs, mechanical loading, and other treatments on the bone healing process in order to accelerate recovery time and bone quality. Most fracture healing studies use animal models to measure the effects of the treatments. Throughout the healing process, the fractured bones are explanted, and the strength of the bones is determined using mechanical tests.

With improvements in computed tomographic (CT) imaging technology (similar to a 3 dimensional x-ray), images of bones down to micron resolution are possible. These images provide information on the shape as well as the mineral density of the bone. The mineral density is proportional to the material properties, in particular the elastic modulus (a high density indicates a large elastic modulus and, therefore, a stiffer the bone). Finite element analysis (FEA) uses a mathematical representation of a structure to determine of the force and displacement at any point within the structure. As input, finite element models require the geometry and the material properties of the structure. Therefore, CT image data is aptly suited as input for finite element models. The objective of this research was to combine CT imaging with finite element analysis in order to predict the strength of a healing bone.

Whereas mechanical testing requires explantation of the bone and usually provides only a single value as an estimate for callus quality, the combination of CT images and FEA has the potential to predict multiple mechanical properties (bending and torsion in multiple planes) in living animals. Predicting mechanical properties from CT images in combination with FEA could prove to

be a useful tool in fracture healing studies, supplementing or replacing biomechanical testing.

Dr. Shefelbine's experience in Ulm has been both academically and personally an invaluable experience. Ulm is particularly well-known for its excellence in experimental research, which was the perfect complement to Shefelbine's primarily theoretical graduate work. Both the personnel and equipment resources in Ulm are outstanding. She has learned numerous experimental techniques from experts in the field, using excellent equipment. A two-year post doctoral fellowship gave her additional publications, confidence, ideas, and direction so that she is now prepared to lead her own research group. In addition to academically preparing her, she has made innumerable contacts and can foresee potential European collaborations.

Primary Goal Indicators:

- Collaborations

Secondary Goal Indicators:

- Global S&E workforce

Other Indicators (Is this work transformative or multidisciplinary?):

No other indicators apply.

This work is notable because
This international experience helped prepare a young researcher for a career in academia which will include long-term research collaborations with scientists from around the world.

O/D/OISE 2005

Program Officer: Susan Parris

NSF Award Numbers:
0202562

Award Title:	International Research Fellowship Program: Prediction of Bone Strength in Fracture Healing Using Quantitative Computed Tomography and Finite Element Analysis
Start Date:	09/01/2002
Expires:	08/31/2004
Awarded Amount to Date:	$81,840
PI:	Sandra Shefelbine, sandras@alumni.princeton.edu
Institution Name:	Shefellbine
Sandra J State Code:	CA
PE Codes:	5956

Appendix B: Non-Response Bias Study

This appendix describes the non-response bias study conducted for the applicant survey. First, it describes the two types of missing data. Next, it describes the analytic approach for addressing each type of non-response.

Types of Missing Data

There are two types of missing data that can arise in a survey, even after repeated attempts to collect data: (1) unit non-response, and (2) item non-response. The approach to dealing with each of these in this study is described below.

Unit Non-Response

Unit non-response occurs when an entire data instrument is not received from a potential respondent. Because non-response was greater than 10 percent, available data were used to explore whether results might be affected by non-response bias. Large differences in the response rates for subgroups could indicate that potential biases may exist.[1] For example, if the response rate from women was very low, and women were less likely to belong to the treatment group, then any observed difference in the outcomes between the treatment and comparison groups could potentially result in a biased estimate of the impact of the treatment. Exhibit B.1 shows the variables used in this analysis. Exhibits B.2 to B.4 show the response rates by groups, suggesting that there were differences in response rates by subgroups.

Exhibit B.1: Variables Used in Non-Response Analysis

Variable	Variable Name	Values	N (%)
Gender	cr_gender_nrbias	0=Male 1=Female	993 (61.00) 635 (39.00)
Under-Represented Minority	Cr_URM_nrbias	0=Non-Minority 1=Minority 2=Missing	1405 (86.30) 100 (6.14) 123 (7.56)
Disability Status	cr_hdcap_nrbias	0=Non-Disabled 1=Disabled 2=Missing	1415 (86.92) 9 (0.55) 204 (12.53)
Cohort	nYear_App_group	1=1991-2000 2=2001-2005 3=2006+	510 (31.33) 586 (36.00) 532 (32.68)
Award Status	nfinalawdfin	0=Non-Awardee 1=Awardee	1064 (65.36) 564 (34.64)
Proposal Score	Finalscore	1-5	Min=1.33, Max=5 Mean=3.97, Std=0.66 N=1628

[1] Note that a large non-response rate does not necessarily create bias. For example, if the non-respondents were similar across the treatment and comparison groups, then the impact estimate would not be biased necessarily; rather, any effect of the program could not be generalized to the non-respondents (i.e. it would create an external validity problem but not necessarily an internal validity issue).

Examining Response Rates Overall

Exhibit B.2: Response Rates by Subgroups of Interest

Characteristic	% Responding (n)			p-value
Gender	**Males** 61.93 (615)	**Females** 66.77 (424)	**Missing** --	0.0475*
Under-Represented Minority	**Non-URM** 68.11 (957)	**URM** 72 (72)	**Missing** 8.13 (10)	<0.0001**
Disability Status	**Non-Disabled** 72.16 (1021)	**Disabled** 44.44 (4)	**Missing** 6.86 (14)	<.0001**
Award Status	**Non-Awardee** 54.7 (582)	**Awardee** 81.03 (457)	**Missing** --	<.0001**
Application Cohort	**1991-2000** 61.18 (312)	**2001-2005** 58.53 (343)	**2006+** 72.18 (384)	<.0001**
Average Proposal Score	**Non-Responders** 3.78 (589)	**Responders** 4.08 (1039)	**Missing** --	<.0001**T

NOTES:
** p-value <0.01
Unless otherwise specified p-values are from a 2X2 chi-square test of the null hypothesis of no association between participation and the characteristic of interest (1 degree of freedom).
F p-value is from the Fisher's Exact Test
T p-value is from the Student's T-Test

Examining Response Rates by Award Status

Exhibit B.3: Response Rates by Subgroups of Interest Controlling for Award Status

Characteristic		% Responding (n)	p-values 2X2 Chi Square	p-values Award Status CMH
Gender				
Non-Awardee	Male	53.24 (345)	0.2529	0.0376*
	Female	56.97 (237)		
Awardee	Male	78.26 (270)	0.0354*	
	Female	85.39 (187)		
URM				
Non-Awardee	Non-URM	59.60 (540)		<0.0001**
	URM	61.67 (37)	<0.0001**	
	Missing	5.10 (5)		
Awardee	Non-URM	83.57 (417)		
	URM	87.5 (35)	<0.0001**	
	Missing	20.00 (5)		
Disabled				
Non-Awardee	Not Disabled	64.49 (572)		<0.0001**
	Disabled	42.86 (3)	<0.0001**	
	Missing	4.17 (7)		
Awardee	Not Disabled	85.04 (449)		
	Disabled	50 (1)	<0.0001**	
	Missing	20.59 (7)		
Application Cohort				
Non-Awardee	1991-2000	48.29 (141)		<0.0001**
	2001-2005	50 (202)	<0.0001**	
	2006+	64.95 (239)		
Awardee	1991-2000	78.44 (171)		
	2001-2005	77.47 (141)	0.016*	
	2006+	88.41 (145)		

Proposal Score	Mean Score[a] Non-Responders	Mean Score[a] Responders	p-value
Non-Awardees	3.62	3.74	0.0006[T]
Awardees	4.49	4.49	0.9929[T]

Missing values are assigned their own level.

** p-value <0.01

Unless otherwise specified p-values are from a 2X2 chi-square test of the null hypothesis of no association between participation and the characteristic of interest (1 degree of freedom).

[a] Mean score is the average of all individual scores assigned by independent reviewers. Scores ranged from 1 (Poor) to 5 (Excellent) and each proposal was typically scored by 3 reviewers.

[T] p-value is from the Student's T-Test

The column labeled "Award Status CMH" shows the p-values from Cochran-Mantel-Haenszel tests of the null hypothesis of no common participation effect across award status.

Examining Response Rates by Application Cohort

Exhibit B.4: Response Rates by Subgroups of Interest Controlling for Application Cohort

Characteristic		% Responding (n)	p-values	
			2X2 Chi Square	Application Cohort CMH
Gender				
1991-2000	Male	58.81 (197)	0.1286	
	Female	65.71 (115)		
2001-2005	Male	59.43 (208)	0.5918	0.0676
	Female	57.20 (135)		
2006+	Male	68.18 (210)	0.0158*	
	Female	77.68 (174)		
URM				
1991-2000	Non-URM	62.02 (285)		
	URM	75 (21)	<0.0001**	
	Missing	9.52 (6)		
2001-2005	Non-URM	63.56 (314)		
	URM	66.67 (26)	<0.0001**	<0.0001**
	Missing	5.66 (3)		
2006+	Non-URM	72.76 (358)		
	URM	75.76 (25)	0.0025**	
	Missing	14.29 (1)		
Disabled				
1991-2000	Not Disabled	67.84 (308)		
	Disabled	66.67 (2)	<0.0001**	
	Missing	3.77 (2)		
2001-2005	Not Disabled	68.29 (336)		
	Disabled	25 (1)	<0.0001**	<0.0001**
	Missing	6.67 (6)		
2006+	Not Disabled	80.38 (377)		
	Disabled	50 (1)	<0.0001**	
	Missing	9.84 (6)		
Award Status				
1991-2000	Non-Awardee	48.29 (141)	<0.0001**	
	Awardee	78.44 (171)		
2001-2005	Non-Awardee	50 (202)	<0.0001**	<0.0001**
	Awardee	77.47 (141)		
2006+	Non-Awardee	64.95 (239)	<0.0001**	
	Awardee	88.41 (145)		

Proposal Score	Mean Score[a] Non-Responders	Mean Score[a] Responders	p-value
1991-2000	3.83	4.13	<0.0001**
2001-2005	3.73	4.07	<0.0001**
2006+	3.79	4.04	<0.0001**

Missing values are assigned their own level.

** p-value <0.01

Unless otherwise specified p-values are from a 2X2 chi-square test of the null hypothesis of no association between participation and the characteristic of interest (1 degree of freedom).

[a] Mean score is the average of all individual scores assigned by independent reviewers. Scores ranged from 1 (Poor) to 5 (Excellent) and each proposal was typically scored by 3 reviewers

[T] p-value is from the Student's T-Test

The column labeled "Application Cohort CMH" shows the p-values from Cochran-Mantel-Haenszel tests of the null hypothesis of no common participation effect across application cohort.

To address the potential for bias, the probability of a person responding to the survey both for responding and non-responding individuals was estimated as function of baseline characteristics that were available for both types of individuals (e.g., proposal score, cohort year, gender), and created weighting classes for adjusting the weights of responding individuals to alleviate the bias due to non-response. Steps 1-4 described below were taken to accomplish this task.

Estimating Probability of Response

Step 1: Fit Models

Logistic regression models were fit to estimate the probability of a person responding to the survey. The response (dependent) variable is a dummy variable that took the value "1" for responding applicants and took the value "0" for non-responding applicants. The explanatory (independent) variables are the variables described in Exhibit B.1. Models also included all two-way interaction terms of award status/application cohort with the other variables described in Exhibit B.1.

Several models were fit to identify the set of explanatory variables that have statistically significant associations with the dependent variable ($p<0.20$ criterion) after controlling for other statistically significant control variables. This was accomplished by using backwards elimination with forward checking. [2] In this method, all of the explanatory variables are entered as predictors in the logistic

[2] Backwards elimination methods are attractive from the point of view that they are often used and familiar. But use of this method with the conventional $p<0.05$ criterion has been criticized from the point of view that the selection criteria tend to favor covariates with strong relationships to the outcome, but may omit important confounders (i.e., variables that have a weaker relationship to the outcome, but have a strong relationship to the predictor variable of interest). Maldonado and Greenland (1993) evaluated a backwards elimination strategy and a change-in-estimate strategy using simulated data from a poisson regression model. They found that the p-value based method performed adequately when the alpha levels were higher than conventional levels (0.20 or more), and found that the change-in-estimate strategy performed adequately when the cut point was set to 10 percent. However, their data, generated from a poisson model, and their analysis model, with only a single covariate in addition to the key exposure variable, are very different than the models anticipated for the current purpose.

Budtz-Jorgensen et al. (2001) compared several covariate selection strategies including backwards elimination and change-in-estimate. They looked at the backwards elimination strategy with three p-value cut-off levels, 0.05, 0.10, and 0.20, and, following the recommendation of Maldonado and Greenland (1993) used a 10% criterion for the change-in-estimate method. They found that, although the change-in-estimate strategy did an adequate job of identifying confounders and keeping them in the model, it sometimes threw out variables that were correlated with the outcome, but were not confounders. Therefore, this method threw out variables that, if retained, would have reduced the residual error and reduced the standard error of the exposure coefficient (thus increasing the power to detect exposure effects – exposure effect is analogous to the key predictor of interest). Although they found that backwards elimination with a $p<0.05$ criterion was un-suited for confounder identification, they found that when the p-value criterion was set to $p<0.20$, backwards elimination strategy resulted in a reduction of residual error variance and did not throw out important confounders. They recommended the backwards elimination strategy with a $p<0.20$ criterion over the change-in-estimate strategy.

Maldonado, G., & Greenland, S. 1993. Simulation study of confounder-selection strategies. *American Journal of Epidemiology,* 138(11), 923-936

regression model. The explanatory variable with the largest non-significant value is dropped from the subsequent model. This step is repeated until the only explanatory variables that remain in the model are those that meet the p<0.20 criterion. In the forwards checking step, each of the previously eliminated control variables is checked by adding each one to the model with only the significant predictors. In this step, each variable has a chance to get back into the model. The final model indicated that the probability of being a responding applicant was related to: final award status (nfinalawdfin), gender (cr_gender_nrbias), cohort year applied (nYear_App_group), final application score (finalscore), handicap status (cr_hdcap_nrbias), the interaction between final award status and gender (nfinalawd*cr_gender_nrbias), and the interaction between cohort year and gender (cr_gender*nYear_App_group). The results from the final model are summarized in Exhibit B.5.

Exhibit B.5: Summary of Final Model Results

Type III Analysis of Effects			
Variable	DF	Wald Chi-Square	Pr > Chisq
nfinalawdfin	1	21.4552	<.0001**
cr_gender_nrbias	1	2.7613	0.0966
nfinalawd*cr_gender_nrbias	1	2.3387	0.1262
cr_gender_nrbias*nYear_App_group	2	4.7379	0.0936
FinalScore	1	5.4213	0.0199*
cr_hdcap_nrbias	2	150.0764	<.0001**
nYear_App_group	2	12.4245	0.0020**

The Logistic Procedure Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.5711	0.5121	48.6368	<.0001**
nfinalawdfin	1	0.8912	0.1924	21.4552	<.0001**
cr_gender_nrbias	1	0.4039	0.2431	2.7613	0.0966
nfinalawd*cr_gender_nrbias	1	0.4554	0.2978	2.3387	0.1262
cr_gender*nYear_App_group_1	1	-0.3637	0.3272	1.2354	0.2664
cr_gender*nYear_App_group_2	1	-0.6737	0.3101	4.7191	0.0298*
FinalScore	1	0.2535	0.1089	5.4213	0.0199**
cr_hdcap_nrbias_0	1	3.5605	0.2919	148.7444	<.0001**
cr_hdcap_nrbias_1	1	2.5692	0.7631	11.3345	0.0008**
nYear_App_group_1	1	-0.6808	0.1932	12.4164	0.0004**
nYear_App_group_2	1	-0.3950	0.1924	4.2152	0.0401

Step 2: Use Model Results to Calculate Response Propensities

In Step 2, parameter estimates obtained from the fitted model were used to calculate the predicted probability that an applicant will respond to the survey. The logistic regression model is represented as:

Budtz-Jorgensen, E., Keilding, N., Grandjean, P., Weihe, P., & White, R. 2001. *Confounder Identification in environmental epidemiology. Assessment of health effects of prenatal mercury exposure.* Retrieved from http://www.pubhealth.ku.dk/bsa/research-reports/paper_ms.ps

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \beta_0 + \sum_k \beta_{ki}$$

where π_i is the probability that applicant i is a responding applicant, and the summation is over the k predictor variables in the final model. The predicted probabilities were obtained by solving the previous equation for π_i, and substituting the parameter estimates from the fitted model in place of the parameters. The solution for the predicted probability for applicant i is given by:

$$\hat{\pi}_i = \frac{\exp(\hat{\beta}_0 + \sum_k \hat{\beta}_{ki})}{1 + \exp(\hat{\beta}_0 + \sum_k \hat{\beta}_{ki})}$$

Each applicant's predicted probability of response ($\hat{\pi}_i$) is called its "response propensity." Applicants with similar response propensities have similar characteristics. In particular, they are similar on the characteristics that are most related to the probability of response.

Step 3: Group Applicants with Similar Response Propensities into Weighting Classes

In this step, applicants with similar response propensities were grouped into weighting classes. The weights of responding applicants within a class were inflated so that the responding applicants within the class represent the population that both the responding and non-responding applicants within the class were originally sampled to represent. Exhibit B.6 shows the distribution of response propensities for the applicant sample.

Exhibit B.6: Distributions of Propensity Scores (All Applicants)

Quantile	Estimate
100% Max	0.9515750
99%	0.9485914
95%	0.8886858
90%	0.8671525
75% Q3	0.8143297
50% Median	0.6901961
25% Q1	0.5703706
10%	0.0793978
5%	0.0344925
1%	0.0254720
0% Min	0.0205654

Weighting classes were formed to ensure that all applicants within a class fell within a narrow range of propensity scores. The boundaries for the weighting classes were determined by creating approximately equal-interval propensity score groupings. The top and the bottom of each propensity interval differed by .10 to .30 points. The resulting five classes corresponded to propensities in the ranges of 2–31, 31–60, 61–70, 71–85, and 86–96 percent probability of response.

Exhibit B.7 shows the frequency and percent of applicants that fell within each of the five weighting classes.

Exhibit B.7: Number and Percent of Applicants in Each of Five Weighting Classes (Results for All Applicants in the Sample)

Weighting Class	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1)Propensities .0-.30	201	12.35	201	12.35
2)Propensities .31-.60	345	21.19	546	33.54
3)Propensities .61-.70	407	25.00	953	58.54
4)Propensities .71-.85	412	25.31	1365	83.85
5)Propensities .85-.96	263	16.15	1628	100.00

Step 4. Within Weighting Class, Inflate Weights of Responding Applicants to Sum to Population Total

Within each weighting class, the weights of all applicants (both responders and non-responders) were summed. Next, the weights of just the responding applicants were summed. Then, within each weighting class, new, adjusted weights of responding applicants were calculated by multiplying the initial weights of 1 by a factor equal to the ratio of the sum of the weights of all applicants to the sum of the weights of the responding applicants. The adjusted weight for the i^{th} applicants in the j^{th} weighting class is represented symbolically by:

$$w_{ij}^{adj} = w_{ij} * \frac{\sum_{k \in responders\ \&\ nonresponders} w_{kj}}{\sum_{i \in responders} w_{ij}}$$

where w_{ij} is the initial sampling weight for the i^{th} applicants in the j^{th} weighting class, the summation in the numerator is over all k applicants in the set of responders and non-responders within weighting class j, the summation in the denominator is over all i applicants in the set of responders in weighting class j, and there are j=1,…, 5 weighting classes. The new, adjusted sampling weights sum to the population total number of applicants. This result can be written symbolically as:

$$\sum_{j} \sum_{i \in responders} w_{ij}^{adj} = \sum_{j} \sum_{k \in responders\ \&\ nonresponders} w_{kj}$$

Exhibit B.8 shows that the weights of the 1628 applicants in the sample sum to the total number of applicants in the target population (N=1628). Exhibit B.9 shows the weights summed within each of the five weighting classes. The sum shown for the j^{th} weighting class (j=1,…,5) corresponds to the term:

$$\sum_{k \in responders\ \&\ nonresponders} w_{kj}$$

For example, the applicant weights of the 201 applicants in the first weighting class sum to:

$$\sum_{k \in responders\ \&\ nonresponders} w_{k1} = 201.$$

Exhibit B.8: Size of Target Population (Sum of Initial Weights for All Applicants in the Sample)

Weight Variable	N	Sum	Minimum	Maximum
Appl_wgt	1628	1628	1.00	1.00

Appl_wgt=the initial weight for all applicants in the sample (sums to the population total number of applicants)

Exhibit B.9: Size of Target Population Within Each Weighting Class (Sum of Weights for All Applicants in the Sample)

Weighting Class		N	Sum	Minimum	Maximum
1)Propensities	.0-.30	201	201	1.00	1.00
2)Propensities	.31-.60	345	345	1.00	1.00
3)Propensities	.61-.70	407	407	1.00	1.00
4)Propensities	.71-.85	412	412	1.00	1.00
5)Propensities	.85-.96	263	263	1.00	1.00

Appl_wgt=initial weight for the applicant sample (sums to population total number of applicants within class)

The sum of the initial weights of the 1,039 responding applicants is shown in Exhibit B.10. These are the "initial weights" because they are the sampling weights prior to adjustment for non-response. The weights of the 1,039 responding applicants sum to a number that is smaller than the size of the target population. Exhibit A.11 shows the weights summed within each of the five weighting classes. The sum shown for the j^{th} weighting class (j=1,…,5) corresponds to the term:

$$\sum_{i \in responders} w_{ij} \ .$$

For example, the initial applicant weights of the n responding applicants in the first weighting class sum to:

$$\sum_{i \in responders} w_{i1} = 12$$

Exhibit B.10: Initial (Unadjusted) Weights of Responding Applicants (Sum of Initial Weights for All 1,039 Responding Applicants)

Variable	N	Sum	Minimum	Maximum
Appl_wgt	1,039	1,039	1.00	1.00

Appl_wgt=the initial weight for the applicant sample

Exhibit B.11: Initial (Unadjusted) Weights of Responding Applicants by Weighting Class (Sum of Initial Weights for All Responding Applicants)

Weighting Class		N	Sum	Minimum	Maximum
1)Propensities	.0-.30	12	12	1.00	1.00
2)Propensities	.31-.60	181	181	1.00	1.00
3)Propensities	.61-.70	287	287	1.00	1.00
4)Propensities	.71-.85	324	324	1.00	1.00
5)Propensities	.85-.96	235	235	1.00	1.00

Appl_wgt=initial weight for the applicant sample (sums to population total number of applicants within class)

The inflation factors for each of the five weighting classes are shown in Exhibit A.12. The inflation factors correspond to the term:

$$\frac{\sum_{k \in responders\ \&\ nonresponders} w_{kj}}{\sum_{i \in responders} w_{ij}}.$$

For example, the inflation factor for the first weighting class is:

$$\frac{201}{12} = 16.75$$

Exhibit B.12: Inflation Factors Within Weighting Classes

Weighting Class	All Applicants
1)Propensities .0-.30	16.75
2)Propensities .31-.60	1.9060773481
3)Propensities .61-.70	1.4181184669
4)Propensities .71-.85	1.2716049383
5)Propensities .85-.96	1.1191489362

Exhibits B.13 and B.14 show the sums of the non-response adjusted weights for the 1039 responding applicants, overall and by weighting class. The adjusted weights sum to the size of the target population. The numbers shown in Exhibits B.13 and B.14 correspond to the term:

$$\sum_{j} \sum_{i \in responders} w_{ij}^{adj}$$

For example, the non-response adjusted applicant weights of the 1039 responder applicants sum to

$$\sum_{j} \sum_{i \in responders} w_{ij}^{adj} = 1628,$$

and, for example, the non-response adjusted applicant weights of the 1039 responding applicants in the bottom weighting class sum to

$$\sum_{i \in responders} w_{i1}^{adj} = 263.$$

Exhibit B.13: Sum of Nonresponse Adjusted Weights for 1039 Responding Applicants

Variable	N	Sum	Minimum	Maximum
appl_wgt_adj	1039	1628	1.1191489	16.7500000

appl_wgt_adj=the adjusted weight for the applicant sample

Exhibit B.14: Sum of Nonresponse Adjusted Weights for 1039 Responding Applicants by Weighting Class

Weighting Class		N	Sum	Minimum	Maximum
1)Propensities	.0-.30	201	201	16.75	16.75
2)Propensities	.31-.60	345	345	1.91	1.91
3)Propensities	.61-.70	407	407	1.42	1.42
4)Propensities	.71-.85	412	412	1.27	1.27
5)Propensities	.85-.96	263	263	1.12	1.12

Appl_wft_adj=the adjusted weight for the applicant sample

Item Non-Response

Item non-response refers to one or more specific uncompleted items on an otherwise completed/returned questionnaire. Since the amount of missing data on an individual item was modest (<5 percent across all returned surveys), descriptive statistics were calculated on only the non-missing items, which is equivalent to an assumption that missing data on an item are missing completely at random. The amount of missing data for each item is presented in all tables/figures included in reports.

Where necessary for the impact analyses, distinct approaches to imputing values were taken depending on whether data were missing for an item used to construct a covariate or predictor variable, or an outcome variable. For impact analyses where missing data on covariate or predictor variables require imputation to prevent having to omit those respondents from the analysis, a "dummy-variable" method was used. This method entailed (i) creating a dummy variable that equals "1" if the value of the variable is missing and "0" otherwise, (ii) adding the dummy variable to the impact model as a covariate, and (iii) replacing the missing value of the original variable with predicted values from a logistic or linear regression model (see Appendix C for more details).

If the missing data occurred in an item used to construct an outcome—that is, one of the primary outcomes of interest (for example, the post-fellowship number of publications produced with a foreign co-author)—no imputation was conducted.

Appendix C: Detailed Description of Impact Analysis

This appendix describes the methodology used to estimate the effects of the IRFP award on its recipients. First, key features of the quasi-experimental design are reviewed in order to provide context for a general discussion of the use of propensity score analysis (PSA) in mitigating selection bias. Next, the steps used to match awardees and non-awardees are presented in detail, including the estimated logistic model and the resulting distribution of awardees and non-awardees in the propensity strata. Finally, specifications of the impact models and sensitivity analyses conducted are presented.

Propensity Score Matching

One of the main purposes of this evaluation was to estimate the effect of IFRP on its participants. If a program brings about changes in its participants, then these individuals should have different outcomes, post-participation, than they would have had in the absence of program participation.

Questions about the impact of a program seek to determine whether any observed differences between participants and non-participants can be attributed to the program itself rather than to other, non-program related causes. One potential source of other causes for differences between the two groups is pre-existing characteristics that could affect both selection into the program and post-program differences, often called "selection bias." Propensity score matching (PSM) was used to mitigate selection bias for this evaluation.

Propensity score matching is one type of propensity score analysis (PSA) wherein participants in a program are matched to non-participants on the basis of their "participation propensity score." This technique uses pre-treatment characteristics to determine the probability (i.e., the propensity score) that applicants would be selected for the treatment (namely, an IRFP award) based on known pre-existing characteristics. After assigning a propensity score to each individual, applicants are placed into blocks (or matching strata) such that the actual IRFP awardees and the unfunded applicants within each block have approximately equal predicted propensity to be in the treated group. The quasi-experimental estimates of the impact of the program can then be obtained by comparing the outcomes of awardees and non-awardees within each propensity block and aggregating the differences across the blocks. This is accomplished by including terms for the propensity blocks in the models used for analysis.

PSM was performed via the following four steps:

Step 1: Identify the pre-treatment characteristics that will be used in the propensity score model to match fellows and unfunded applicants.

The pre-treatment characteristics to be used in the propensity score model to match fellows and unfunded applicants were identified. These characteristics included variables that both predicted receiving the fellowship and might also affect the outcomes of interest. They were taken from NSF extant data and applicant survey data. Exhibit C.1 shows the variables used in the propensity score model.

Some of the characteristics to be used in the PSA had missing data. If these missing data had been ignored, records that had missing data in the PSA matching would have been lost. A recommended approach for addressing this issue is to do a simple single imputation of the missing covariates and include missing data indicators in the propensity score model. This method essentially matches both on the observed values and on the missing data patterns.[3] Although it cannot balance the missing data values themselves this method will yield balance on the covariates and the missing data patterns.[4]

Single imputation substitutes a missing value with a definite value following an established procedure. Predicted values from a logistic or linear regression model were used to impute a definite value for missing values in this study. The outcomes for these models were the PSA variables that had missing data and the predictors were all PSA variables with non-missing data. Imputation was done first for the variable with the least amount of missing. This variable was then added to the right hand side of the model for the next variable with the least amount of missing. This process continued through to the variable with the most number of cases missing with all of the other PSA variables. For binary variables a imputation was done using randomly generated a 0 or 1 using a binomial distribution with p=predicted probability from the model discussed above. For continuous variable the predicted values generated from the model was used as the imputed value. Imputation flags were created to indicate if an observation was imputed or not to include in the PSA model. Exhibit C.2 shows the distribution of each variable overall and by award status prior and post-imputation.

[3] Stuart, E.A. 2010. Matching methods for casual inference: A review and a look forward. *Statistical Science,* 25(1), 1-21.

[4] Rosenbaum, P.R., & Rubin, D.B. 1984. Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association,* 79, 516 -524.

Exhibit C.1: Pre-Award Data Used to Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

Pre-Award Characteristic	Reason for Inclusion in Propensity Score Model[1]	Data Source(s)	Type	Definition
Mean proposal score	Proposal score indicates quality of application	NSF Extant Data	Continuous	Average score across reviews (1-5)
Cohort year	Control for cohort differences	NSF Extant Data	Dichotomous	1992 (0/1) 1993 (0/1) 1994 (0/1) 1995 (0/1) 1996 (0/1) 1997 (0/1) 1998 (0/1) 1999 (0/1) 2000 (0/1) 2001 (0/1) 2002 (0/1) 2003 (0/1) 2004 (0/1) 2005 (0/1) 2006 (0/1) 2007 (0/1) 2008 (0/1) 2009 (0/1)
Geographic density	Desire for geographic balance in portfolio[a]	NSF Extant Data	Dichotomous	North America (0/1) South/Central America (0/1) Europe (0/1) Africa /Middle East (0/1) South Pacific (0/1) East Asia (0/1)
Gender	Preference given for females (women encouraged to apply)[a]	IFRP Applicant Survey: G1	Dichotomous	1=Female 0=Male
Under-represented minority status	Preference given for under-represented minority status (members of these groups were encouraged to apply)[a]	IFRP Applicant Survey: G2, G3	Dichotomous	1=Other race(s)/ethnicity 0=Asian Only or White Only

Exhibit C.1: Pre-Award Data Used to Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

Pre-Award Characteristic	Reason for Inclusion in Propensity Score Model[1]	Data Source(s)	Type	Definition
Citizenship status	US citizenship (birth, naturalized) or permanent residency required [a]	IFRP Applicant Survey: G4, G4a	Dichotomous	1=US Citizen/Permanent Resident 0=Non-US Citizen or Permanent Resident
Disability status	Preference given to disabled applicant (disabled applicants encouraged to apply) [a]	IFRP Applicant Survey: G5	Dichotomous	1=Disabled 0=Not-Disabled
STEM discipline	Desire for disciplinary balance in program portfolio [a]	IFRP Applicant Survey: A5	Dichotomous	Biological, agricultural, or environmental life sciences (1/0) Physical and related sciences (includes Chemistry except biochem; earth, atmospheric, ocean sciences; physics) (1/0) Computer and information sciences & Mathematics and statistics (1/0) Psychology & social sciences &related science (1/0) Engineering (1/0) Health (non-STEM) 1/0)
Had tenure-track position	Priority given to applicants not in a tenure-track position [a]	IFRP Applicant Survey: C1	Dichotomous	1=Not on tenure track 0=On tenure track
Highest degree held	Need to have a PhD at time of award [a]	IFRP Applicant Survey: C2a	Dichotomous	1=Doctoral degree (PhD, EdD, MD, joint MD/PhD, JD, PsyD, ScD) 0=Other Degree
Degree from non-US institution	Lower priority given to applicants with a PHD from a foreign institution [a]	IFRP Applicant Survey: C2b	Dichotomous	1=No degree from a non-US institution 0=Degree from a non-US institution
Study-abroad as undergraduate	Preference given to those with no prior international experience [a]	IFRP Applicant Survey: C3a	Dichotomous	1=No prior experience studying abroad
Study-abroad as grad student	Preference given to those with no prior international experience (applicant must justify award) [a]	IFRP Applicant Survey: C3b	Dichotomous	0=Prior experience studying abroad
Prior international residential	Preference given to those with no prior international experience [a]	IFRP Applicant Survey: C4	Dichotomous	1=No prior experience living abroad 0=Prior experience living abroad

Exhibit C.1: Pre-Award Data Used to Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

Pre-Award Characteristic	Reason for Inclusion in Propensity Score Model[1]	Data Source(s)	Type	Definition
Prior international collaboration	Likely to be beneficial to applicant	IFRP Applicant Survey: C4, C5b	Dichotomous	1=Prior international collaboration 0=No prior international collaboration
Already at host institution	Unfavorable for IRFP applicant (applicant must justify award) [a]	IFRP Applicant Survey: C5a	Dichotomous	1=Not working at a foreign institution 0=Working at a foreign institution
Prior international exposure	Prior exposure to foreign colleagues or former program fellow favorable to applicant	IFRP Applicant Survey: C4	Dichotomous	1=Prior exposure to foreign colleagues or former program fellow 0=No prior exposure to foreign colleagues or former program fellow
Link between US, host institutions	Likely to be beneficial to applicant	IFRP Applicant Survey: C6	Dichotomous	1=Link between US, host institutions 0=No Link between US, host institutions
Total pre-award publications	Prior record of achievement favorable[a]	IFRP Applicant Survey: C7	Continuous	Total pre-award publication
% publications w/foreign collaborator	Likely to be beneficial to applicant	IFRP Applicant Survey: C7	Continuous	Percent of publications with foreign collaborator
National post-collegiate fellowship	Prior record of achievement favorable [a]	C8	Dichotomous	1=Received a national post-collegiate fellowship 0=Did not received any national post-collegiate fellowship

[a] These criteria were based on information provided in one or more of the following NSF solicitations: 00-141, 01-135, 02-149, 05-599, and 06-582.

Exhibit C.2: Distribution of Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

		Prior to Imputation					Post-Imputation				
Pre-Award Characteristic	Variable	N	N miss	Min	Max	Mean/ Percent	N	N miss	Min	Max	Mean/ Percent
Among All Applicants											
Mean Proposal Score	finalscore	1039	0	1.33	5	4.1	1039	0	1.33	5	4.1
Cohort Year	CohortYr	1039	0	1992	2009	2002.7	1039	0	1992	2009	2002.7
Geographic Density	NrthAmerica_PSM	1010	29	0	1	9.6%	1039	0	0	1	9.3%
	SthCenAmerica_PSM	1010	29	0	1	8.8%	1039	0	0	1	8.6%
	Europe_PSM	1010	29	0	1	59.5%	1039	0	0	1	60.3%
	AfricaME_PSM	1010	29	0	1	5.8%	1039	0	0	1	6.1%
	SthPac_PSM	1010	29	0	1	10.8%	1039	0	0	1	10.5%
	EAsia_PSM	1010	29	0	1	5.4%	1039	0	0	1	5.3%
Gender	Female_PSM	1039	0	0	1	59.2%	1039	0	0	1	59.2%
Under-Represented Minority Status	**cr_urm_PSM**	**1029**	**10**	**0**	**1**	**7.0%**	**1039**	**0**	**0**	**1**	**7.0%**
Citizenship Status	Citizen_PSM	1034	5	0	1	99.8%	1039	0	0	1	99.8%
Disability status	hdcap_PSM	1025	14	0	1	0.4%	1039	0	0	1	0.4%
STEM Discipline	Bioagenv_PSm	1039	0	0	1	47.6%	1039	0	0	1	47.6%
	CompMathStat_PSM	1039	0	0	1	6.0%	1039	0	0	1	6.0%
	Physical_PSM	1039	0	0	1	27.3%	1039	0	0	1	27.3%
	Socal_PSM	1039	0	0	1	6.8%	1039	0	0	1	6.8%
	Engineering_PSM	1039	0	0	1	12.0%	1039	0	0	1	12.0%
	Health_PSM	1039	0	0	1	0.2%	1039	0	0	1	0.2%
Tenure Track Position	Notenuretrack_PSM	1037	2	0	1	94.7%	1039	0	0	1	94.7%
Graduate Degree Program	PhD_PSM	1039	0	0	1	94.4%	1039	0	0	1	94.4%
Degree from Foreign Institution	Noforeigndegree_PSM	1035	4	0	1	92.0%	1039	0	0	1	92.0%
Study Abroad as an undergraduate or graduate	NoStudAbr_PSM	1034	5	0	1	43.2%	1039	0	0	1	43.0%

Exhibit C.2: Distribution of Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

		Prior to Imputation					Post-Imputation				
Pre-Award Characteristic	Variable	N	N miss	Min	Max	Mean/ Percent	N	N miss	Min	Max	Mean/ Percent
Prior visit to host location	Nopriorres_PSM	1039	0	0	1	55.2%	1039	0	0	1	55.2%
Prior international collaboration	priorcollab_PSM	1035	4	0	1	54.4%	1039	0	0	1	54.3%
Located at Host University	Notathost_PSM	1034	5	0	1	86.4%	1039	0	0	1	86.4%
Prior international exposure	priorexpose_PSM	1035	4	0	1	72.7%	1039	0	0	1	72.7%
Link between host, US institution	linkhost_PSM	1030	9	0	1	34.0%	1039	0	0	1	33.8%
Total Pre-Award publications	AllWorks	990	49	0	80	9.3	1039	0	0	80	9.3
Percent of publications with a foreign collaborator	percentworks	983	56	0	100	16.1	1039	0	0	100	16.0
National post-collegiate fellowship	fellow_PSM	1026	13	0	1	45.5%	1039	0	0	1	45.1%
Among Awardees Only											
Mean Proposal Score	finalscore	457	0	3	5	4.5	457	0	3	5	4.5
Cohort Year	CohortYr	457	0	1992	2009	2001.9	457	0	1992	2009	2001.9
Geographic Density	NrthAmerica_PSM	457	0	0	1	9.2%	457	0	0	1	9.2%
	SthCenAmerica_PSM	457	0	0	1	10.3%	457	0	0	1	10.3%
	Europe_PSM	457	0	0	1	58.6%	457	0	0	1	58.6%
	AfricaME_PSM	457	0	0	1	6.3%	457	0	0	1	6.3%
	SthPac_PSM	457	0	0	1	10.3%	457	0	0	1	10.3%
	EAsia_PSM	457	0	0	1	5.3%	457	0	0	1	5.3%
Gender	Female_PSM	457	0	0	1	59.1%	457	0	0	1	59.1%

Exhibit C.2: Distribution of Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

		Prior to Imputation					Post-Imputation				
Pre-Award Characteristic	Variable	N	N miss	Min	Max	Mean/ Percent	N	N miss	Min	Max	Mean/ Percent
Under-Represented Minority Status	cr_urm_PSM	452	5	0	1	7.7%	457	0	0	1	7.9%
Citizenship Status	Citizen_PSM	455	2	0	1	99.6%	457	0	0	1	99.6%
Disability status	hdcap_PSM	450	7	0	1	0.2%	457	0	0	1	0.2%
STEM Discipline	Bioagenv_PSm	457	0	0	1	43.3%	457	0	0	1	43.3%
	CompMathStat_PSM	457	0	0	1	6.3%	457	0	0	1	6.3%
	Physical_PSM	457	0	0	1	29.5%	457	0	0	1	29.5%
	Socal_PSM	457	0	0	1	8.8%	457	0	0	1	8.8%
	Engineering_PSM	457	0	0	1	11.8%	457	0	0	1	11.8%
	Health_PSM	457	0	0	1	0.2%	457	0	0	1	0.2%
Tenure Track Position	Notenuretrack_PSM	457	0	0	1	95.0%	457	0	0	1	95.0%
Graduate Degree Program	PhD_PSM	457	0	0	1	97.8%	457	0	0	1	97.8%
Degree from Foreign Institution	Noforeigndegree_PSM	457	0	0	1	92.1%	457	0	0	1	92.1%
Study Abroad as an undergraduate or graduate	NoStudAbr_PSM	456	1	0	1	45.4%	457	0	0	1	45.3%
Prior visit to host location	Nopriorres_PSM	457	0	0	1	52.7%	457	0	0	1	52.7%
Prior international collaboration	priorcollab_PSM	455	2	0	1	56.9%	457	0	0	1	56.9%
Located at Host University	Notathost_PSM	456	1	0	1	90.1%	457	0	0	1	90.2%
Prior international exposure	priorexpose_PSM	455	2	0	1	73.4%	457	0	0	1	73.5%
Link between host, US institution	linkhost_PSM	454	3	0	1	34.6%	457	0	0	1	34.4%
Total Pre-Award publications	totalworks	441	16	0	55	9.1	457	0	0	55	9.1

Exhibit C.2: Distribution of Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

		Prior to Imputation					Post-Imputation				
Pre-Award Characteristic	Variable	N	N miss	Min	Max	Mean/ Percent	N	N miss	Min	Max	Mean/ Percent
Percent of publications with a foreign collaborator	percentworks	437	20	0	100	16.5	457	0	0	100	16.3
National post-collegiate fellowship	fellow_PSM	454	3	0	1	49.8%	457	0	0	1	49.2%
Among Declines Only											
Mean Proposal Score	finalscore	582	0	1.33	5	3.7	582	0	1.33	5	3.7
Cohort Year	CohortYr	582	0	1992	2009	2003.4	582	0	1992	2009	2003.4
Geographic Density	NrthAmerica_PSM	553	29	0	1	9.9%	582	0	0	1	9.5%
	SthCenAmerica_PSM	553	29	0	1	7.6%	582	0	0	1	7.2%
	Europe_PSM	553	29	0	1	60.2%	582	0	0	1	61.5%
	AfricaME_PSM	553	29	0	1	5.4%	582	0	0	1	5.8%
	SthPac_PSM	553	29	0	1	11.2%	582	0	0	1	10.7%
	EAsia_PSM	553	29	0	1	5.6%	582	0	0	1	5.3%
Gender	Female_PSM	582	0	0	1	59.3%	582	0	0	1	59.3%
Under-Represented Minority Status	cr_urm_PSM	577	5	0	1	6.4%	582	0	0	1	6.4%
Citizenship Status	Citizen_PSM	579	3	0	1	100.0%	582	0	0	1	100.0%
Disability status	hdcap_PSM	575	7	0	1	0.5%	582	0	0	1	0.5%
STEM Discipline	Bioagenv_PSm	582	0	0	1	51.0%	582	0	0	1	51.0%
	CompMathStat_PSM	582	0	0	1	5.7%	582	0	0	1	5.7%
	Physical_PSM	582	0	0	1	25.6%	582	0	0	1	25.6%
	Socal_PSM	582	0	0	1	5.3%	582	0	0	1	5.3%
	Engineering_PSM	582	0	0	1	12.2%	582	0	0	1	12.2%
	Health_PSM	582	0	0	1	0.2%	582	0	0	1	0.2%
Tenure Track Position	Notenuretrack_PSM	580	2	0	1	94.5%	582	0	0	1	94.5%

Exhibit C.2: Distribution of Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

		Prior to Imputation					Post-Imputation				
Pre-Award Characteristic	Variable	N	N miss	Min	Max	Mean/ Percent	N	N miss	Min	Max	Mean/ Percent
Graduate Degree Program	PhD_PSM	582	0	0	1	91.8%	582	0	0	1	91.8%
Degree from Foreign Istitution	Noforeigndegree_PSM	578	4	0	1	91.9%	582	0	0	1	91.9%
Study Abroad as an undergraduate or graduate	NoStudAbr_PSM	578	4	0	1	41.5%	582	0	0	1	41.2%
Prior visit to host location	Nopriorres_PSM	582	0	0	1	57.2%	582	0	0	1	57.2%
Prior international collaboration	priorcollab_PSM	580	2	0	1	52.4%	582	0	0	1	52.2%
Located at Host University	Notathost_PSM	578	4	0	1	83.4%	582	0	0	1	83.5%
Prior international exposure	priorexpose_PSM	580	2	0	1	72.1%	582	0	0	1	72.0%
Link between host, US institution	linkhost_PSM	576	6	0	1	33.5%	582	0	0	1	33.3%
Total Pre-Award publications	totalworks	549	33	0	80	9.5	582	0	0	80	9.5
Percent of publications with a foreign collaborator	percentworks	546	36	0	100	15.9	582	0	0	100	15.8
National post-collegiate fellowship	fellow_PSM	572	10	0	1	42.1%	582	0	0	1	41.9%

Step 2: Fit a logistic model that predicts the probability of being awarded a fellowship based on pre-treatment characteristics.

The participation propensity score for each individual was estimated using a logistic model with the identified pre-treatment characteristics (see exhibit C.3) as the independent variables and receipt of the fellowship (dummy-coded as 0 or 1) as the dependent variable. In general, variables were not excluded from the logistic model merely because of a lack of significance, i.e., variables were included regardless of whether they predicted treatment. Collinearity was accepted among the predictors because the model was not intended to predict anything outside the sample space. Exhibit C.3 displays the resulting logistic model. The coefficients from this model were used to estimate the propensity score for each individual, which represents the probability of receiving a fellowship.

Exhibit C.3: Propensity Score Logistic Model

Variable	Coefficient	Standard Error	Prob > |z|
FinalScore	4.0709	0.2668	0.000
CohortYr	-0.0854	0.0192	0.000
SthCenAmerica_PSM	-1.7672	0.6802	0.009
Europe_PSM	0.1085	0.3065	0.723
AfricaME_PSM	-0.9404	0.4809	0.051
SthPac_PSM	-0.2880	0.3990	0.470
EAsia_PSM	-1.1390	0.5188	0.028
Female_PSM	0.2455	0.1835	0.181
cr_urm_PSM	-1.3068	0.3926	0.001
cr_urm_PSM_imp_flg	0.4782	1.1408	0.675
hdcap_PSM	0.7882	1.2939	0.542
hdcap_PSM_imp_flg	-0.3034	0.8680	0.727
Bioagenv_psm	1.2655	3.0182	0.675
CompMathStat_PSM	1.0035	3.0395	0.741
Physical_PSM	0.8655	3.0224	0.775
Socal_PSM	0.3697	3.0330	0.903
Engineering_PSM	0.9304	3.0326	0.759
Notenuretrack_PSM	-1.0094	0.4413	0.022
PhD_PSM	-1.3322	0.4660	0.004
Noforeigndegree_PSM	0.2319	0.3410	0.496
NoStudAbr_PSM	-0.0668	0.2091	0.749
Nopriorres_PSM	0.5391	0.3705	0.146
priorcollab_PSM	-0.2036	0.2172	0.349
Notathost_PSM	-1.1177	0.2800	0.000
priorexpose_PSM	0.5182	0.3513	0.140
priorexpose_imp_flg	-1.4254	1.7302	0.410
linkhost_PSM	-0.0050	0.1927	0.980
linkhost_PSM_imp_flg	1.1409	1.5081	0.449
allworks	-0.0120	0.0109	0.270
allworks_imp_flg	-0.8153	0.9193	0.375
Percentworks	0.0023	0.0039	0.561
fellow_psm	0.1804	0.1880	0.337
fellow_imp_flg	1.7979	0.9577	0.060
nopriorexpose	-0.5481	0.4193	0.191
urm_link_flg	-2.1939	2.5238	0.385
Sth_priorex	0.6974	0.7249	0.336

Exhibit C.3: Propensity Score Logistic Model

Variable	Coefficient	Standard Error	Prob > |z|
_cons	158.8441	47.4621	0.001

Number of observations=1039 Pseudo $R^{2=}$0.4247
LR chi^2 (36)=605.29 Log-likelihood=-409.99761
Prob > chi^2=0.0000

NOTES: In estimating the propensity score through a probability model, the choice of which interaction term to include is determined solely by the need to condition fully on the observable characteristics that make up the assignment mechanism. When covariates are not balanced within a particular stratum, the solution adopted is to divide the stratum into finer strata and test again for no difference in the distribution of covariates within the finer strata. If however, some covariates still remain unbalanced, the score may be poorly estimated which suggests that additional terms (interaction or higher-order terms) of the unbalanced covariates should be added to the logistic specification to control better for these characteristics. This procedure is repeated until the covariates are balanced.[5]

Step 3: Use the estimated propensity scores to create matched sets of fellows and unfunded applicants.

The estimated propensity scores were used to create matched sets of fellows and unfunded applicants. Propensity scores can be utilized in a number of ways, including matching, stratification, weighting, and regression adjustment.[6] Stratification (also called interval matching) was the primary method of matching. This method was chosen because it allows for the inclusion of the largest number of cases and does not impose a functional form (e.g., linear) on the relationship between propensity to participate and treatment effect. Once the propensity scores were assigned, the region of common support was defined as [.00258812, .9961853]. Individuals were identified and excluded from the analyses if they were outside of the "common support" group—the range of common scores across fellows and unfunded applicants. Enforcing the common support is important to ensure the similarity of the matched non-awardees to awardees.[7] Zero awardees and 32 non-awardees were dropped because their propensity score was outside of this range.

The remaining individuals were divided into strata within which the awardee and non-awardee groups had statistically the same[8] mean propensity score. Within each of these strata tests were conducted to identify significant differences between the treatment and comparison group on the independent variables. The model was adjusted until all such differences were removed.[9]

The treatment and comparison groups were divided into seven strata based on their propensity scores. Research has indicated that at least five strata are generally sufficient for removing 90

5 See Deheija, R.H., & Wahba, S. 2002. Propensity score-matching methods for non-experimental casual studies. *The Review of Economics and Statistics,* 84(1), 161.

6 Hirano, K., Imbens, G.W., & Ridder, G. 2003. Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*, 71(4), 1161-1189; Morgan, S.L., & Harding, D. J. 2006. Matching estimators of causal effects: Prospects and pitfalls in theory and practice. *Sociological Methods & Research*, 35(1), 3–60; and Abadie, A., & Imbens, G.W. 2009. *Matching on the estimated propensity score* (NBER Working Paper 15301).

7 Rosenbaum & Rubin, 1984; Caliendo, M., & Kopeinig, S. 2007. Some Practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, 22(1), 31-72.

8 Based on level p<0.01 t-tests.

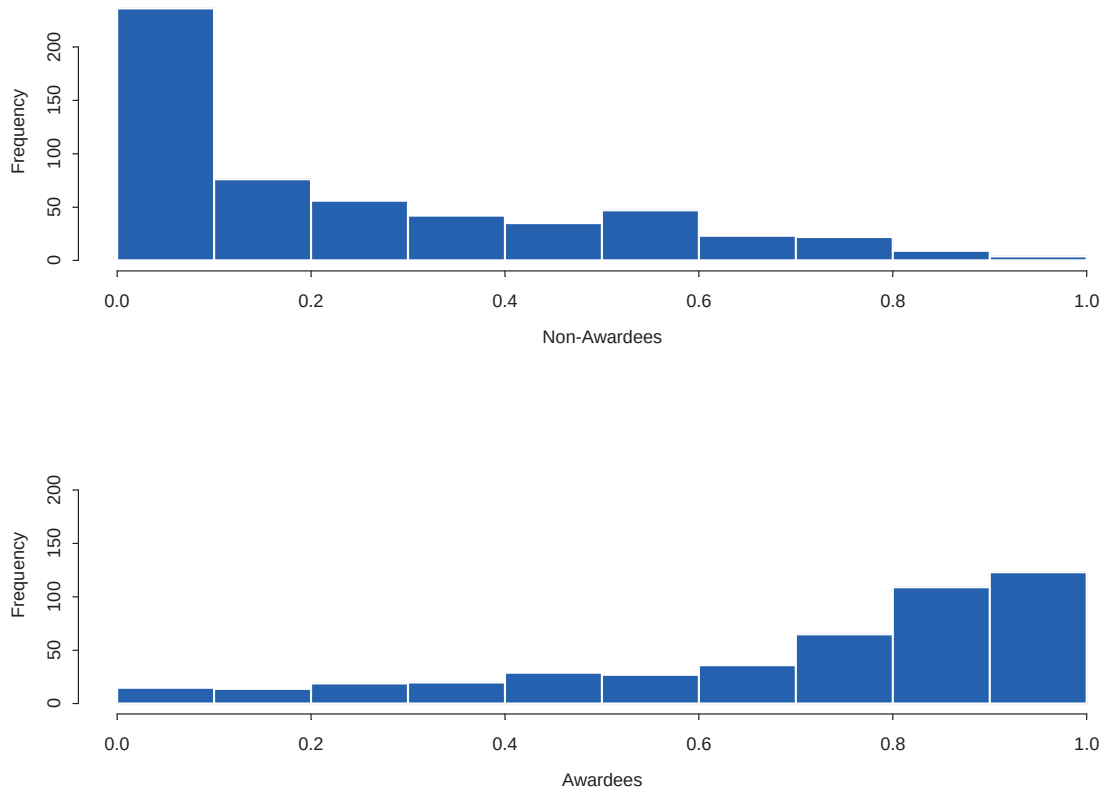
9 The Intercooled STATA10 pscore process was used to obtain propensity score balance.

percent or more of the bias due to the covariates.[10] Exhibit C.4 shows the distribution of the treatment and comparison group members by propensity score strata. Exhibit C.5 shows a histogram of propensity scores for the treatment and comparison groups.

Exhibit C.4: Number of Awardee and Non-Awardee in each Propensity Score Block

Inferior of Block of Pscore	Non-Awardee	Awardee	Total
0.0025881	175	5	180
0.05	61	10	71
0.1	76	14	90
0.2	98	39	137
0.4	82	56	138
0.6	45	101	146
0.8	13	232	245
Total	550	457	1,007
Number outside the region of common support	32	0	32

Exhibit C.5: Histograms of Propensity Scores



[10] Rosenbaum & Rubin, 1984.

Step 4: Test whether there are any differences between the awardees and non-awardees within each propensity score strata.

This analysis was conducted in two ways. First, t-tests were used to determine if there were any difference for awardees and non-awardees within each stratum for each pre-treatment characteristic.[11] As this test is sensitive to sample size (i.e., they tend fail to detect sizable differences in small samples, but detect slight differences in larger samples), this analysis was supplemented using standardized differences.[12] The standardized difference of a matching characteristic between awardees and non-awardees in a given propensity score stratum is calculated using the following formula:

$$B_{X,S} = \frac{|\overline{X}_{T,S} - \overline{X}_{C,S}|}{\sqrt{\frac{1}{2}\sigma^2{}_{X,T} + \frac{1}{2}\sigma^2{}_{X,C}}}$$

Where:

X denotes the variable of interest;

S denotes the stratum;

T denotes the treatment group, and C denotes the comparison group;

$\overline{X}_{T,S}$ and $\overline{X}_{C,S}$ denote the treatment and comparison group mean of X in stratum S ; and

$\sigma^2{}_{X,T}$ and $\sigma^2{}_{X,C}$ denote the overall variance of X in the treatment and comparison group, respectively.

For regression adjustments to be trustworthy standardized differences of means should be less that 0.25[13] and you want very few of significant t-tests.[14] Checks were conducted for statistical balance and modified the models in step 2 by including interactions and higher-order terms of the unbalanced characteristics until satisfactory statistical balance was achieved i.e. models were improved until it was no longer possible to reduce the number of significant t-tests or standardized differences <0.25. For this study total of five models that achieved propensity score balance to achieve this result were fit.

Pre-treatment characteristics and standardized differences between awardees and non-awardees within each of the seven strata were examined. The sizes of the treatment-control differences

[11] Dehejia & Wahba, 2002; Agodini, R., & Dynarski, M. 2004. Are experiments the only option? A look at dropout prevention programs. *Review of Economics and Statistics*, 86(1), 180-194.

[12] Morgan, S.L., & Winship, C. 2008. *Counterfactuals and causal inference: Methods and principles for social Research*. New York: Cambridge University Press.

[13] Rubin, D.B. 2001. Using propensity scores to help design observational studies: Application to the tobacco litigation. *Health Services and Outcomes Research Methodology,* 2, 169-188.

[14] Stuart, 2010.

expressed in standard deviation units (standardized differences) ranged from 0.020 to 0.794 (there were five standardized differences greater than 0.25), with the largest differences in the block with the smallest awardee group size (block 1). Controls were included the impact model for any characteristics in the impact models whose standardized differences were greater than 0.25.

Impact Models

Following the propensity score matching, the impact of the IRFP program was estimated by comparing fellows' outcomes to those of their comparison group to determine what fellows' expected outcomes would have been had they not received an IRFP award.

Estimation of Impacts

After creating the propensity score strata, a multivariable regression model was used to estimate the impact of the program of interest. This regression model employed a number of matching characteristics and other variables (see Exhibit C.6) that are hypothesized to affect the outcomes of interest such as covariates. The inclusion of the matching characteristics in this model give us the chance to get a "doubly-robust" impact estimate since they would have been used twice: both in the propensity score model and in the estimation of impacts.[15] The following regression model was used to estimate the program impact:[16]

Impact Model

$$[1]\quad Y_i = \beta_0 + \beta_1 T_i + \sum_{j=1}^{b-1} \beta_{j+1} S_i^j + \sum_{j=1}^{b-1} \beta_{j+b} T_i S_i^j + \sum_{n=1}^{N} \beta_{n+(b+3)} X_i^n + \varepsilon_i$$

Where:

Y_i is the outcome of interest for individual i,

T_i is the treatment indicator for individual i (1=awardee , 0=non-awardee),

S_i^j is the indicator (dummy) variable for the j^{th} propensity score stratum. The prototypical model includes the total number of strata (*b*) minus one strata indicators (j=1,2 ,…, b-1). The last stratum is the reference stratum and a dummy for this stratum is not included in the model,

X_i^n is the n^{th} (n=1,2,…,N) covariate for individual i (such as gender, URM, etc.) that are grand-mean centered, and

ε_i is the usual error term for individual Interpretation of parameters

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15 Ho, D.E., Imai, K., King, G., & Stuart, E. A. 2007. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis,* 15, 199–236.; Morgan S.L., & Harding, D. J. 2006. Matching estimators of causal effects: Prospects and pitfalls in theory and practice. *Sociological Methods & Research*, 35(1), 3–60.

16 For illustrative purposes, the impact model is presented for continuous outcomes. For binary outcomes, a logistic model was fit structured similarly to the model in Equation 1.

Interpretation of the coefficients in the model is as follows:

$\hat{\beta}_0$ is the covariate-adjusted mean value of the outcome for the non-awardees in the reference propensity score stratum,

$\hat{\beta}_0 + \hat{\beta}_{j+1}$ (j=1,2,…,b-1) is the covariate-adjusted mean value of the outcome for the non-awardees in the j^{th} stratum,

$\hat{\beta}_1$ is the impact estimate for the reference stratum (i.e. the difference between the mean value of the outcome of the awardees and non-awardees in the reference stratum),

$\hat{\beta}_{j+b}$ (j=1,2,…,b-1) is the difference between the impact estimate for the j^{th} stratum and the impact estimate for the reference stratum,

$\hat{\beta}_1 + \hat{\beta}_{j+b}$ (j=1,2,…,b-1) is the impact estimate (i.e., the covariate adjusted difference between the outcomes of the awardees and non-awardees) for the j^{th} stratum, and

$\hat{\beta}_{n+(b+3)}$ (n=1,2,…,N) is the estimated overall relationship between the n^{th} covariate and the outcome controlling for other covariates.

Treatment Effects

Overall treatment effect (estimated impact)

As seen, the model in Equation 1 allows for the estimation of separate treatment effect estimates for each propensity score stratum. More specifically, $\hat{\beta}_1 + \hat{\beta}_{j+b}$ (j=1,2,…,b-1) is the impact estimate for the j^{th} (j=1, 2,…, b-1) stratum. In order to calculate an overall treatment effect estimate, the stratum-specific estimates are aggregated as follows[17]:

[2] $TE = \sum_{j=1}^{b-1} P_j \, (\hat{\beta}_1 + \hat{\beta}_{j+b}) + P_r \, \hat{\beta}_1$; where

P_j is the proportion of treatment group members in the j^{th} stratum (i.e. $\frac{n_j}{N}$, where N is the total number of awardees in the sample and n_j is the number of awardees in the j^{th} stratum) , and

P_r is the proportion of treatment group members in the reference stratum.

[17] Stratum-specific treatment effect estimates can be aggregated to yield an overall impact estimate in a number of ways. The method chosen here—weighing the estimate for each stratum by the proportion of treatment group members in that stratum—is widely used (Morgan & Harding, 2006; Caliendo & Kopeinig, 2007).

Overall covariate-adjusted mean for non-awardees

[3] $\bar{Y}_{AdjNonAwardees} = \sum_{j=1}^{b-1} P_j \, (\hat{\beta}_0 + \hat{\beta}_{j+1}) + P_r \, \hat{\beta}_0$; where

P_j is the proportion of treatment group members in the j[th] stratum (i.e. $\frac{n_j}{N}$, where N is the total number of awardees in the sample and n_j is the number of awardees in the j[th] stratum) , and

P_r is the proportion of treatment group members in the reference stratum.

Overall Covariate-Adjusted Mean for Awardees

[4] $\bar{Y}_{AdjAwardeesr} = \bar{Y}_{AdjNonAwardees} + TE$

Estimated coefficients from the impact model and the overall impact estimate are presented as well as their corresponding standard errors and p-values. Hence, for dichotomous outcomes, impact estimates are presented in the form of percentage points. For continuous outcomes, overall impact estimates in "effect size" units (e.g., Hedges' *g*) are also presented. The effect size for an impact estimate was calculated as:

[5] $ES = \frac{TE}{PooledSD}$

Where

TE is calculated as shown in Equation 2, and

[6] $PooledSD = \sqrt{\frac{(N_t - 1)S_t^2 + (N_c - 1)S_c^2}{(N_t - 1) + (N_c - 1)}}$

Where

N_t=sample size of treatment group,

N_c=sample size of comparison group,

S_t^2=variance of the outcome for treatment group (unadjusted), and

S_c^2=variance of the outcome for comparison group (unadjusted).

Exhibit C.6: Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

Covariate	Reason for Inclusion in Impact Model	Data Source(s)	Type	Definition
Mean proposal score	Proposal score indicates quality of application: Characteristic was not balanced in block 7	NSF Extant Data	Continuous	Average score across reviews (1-5)
Gender	Control for gender differences	IFRP Applicant Survey: G1	Dichotomous	1=Female 0=Male
Under-represented minority status (URM)	Preference given for under-represented minority status (members of these groups were encouraged to apply): Characteristic was not balanced in block 4 and 6	IFRP Applicant Survey: G2, G3	Dichotomous	1=Other race(s)/ethnicity 0=Asian Only or White Only
Under-represented minority status imputation flag	Flag to represent missing data pattern for URM variable: URM was not balanced in block 4 and 6	Abt Created	Dichotomous	1=imputed 0=not imputed
South Central America	Application was to South Central America: Characteristic was not balanced in block 2	NSF Extant Data	Dichotomous	1=South/Central America 0=Rest of the world
Number of years since completing PhD	Control for number of years since completing PhD	IRFP Applicant Survey: A4a	Continuous	Number of years (0-23)
Applicant had a Biological, agricultural, or environmental life sciences degree	Applicants field of study was biological, agricultural, or environmental life sciences: Characteristic was not balanced in block 2	IFRP Applicant Survey: A5	Dichotomous	1=Biological, agricultural, or environmental life sciences 0=Rest of disciplines
Prior international exposure	Control for prior exposure to foreign colleagues or former program fellow favorable to applicant: Characteristic was not balanced in block 2	IFRP Applicant Survey: C4	Dichotomous	1=Prior exposure to foreign colleagues or former program fellow 0=No prior exposure to foreign colleagues or former program fellow
Total pre-award publications	Control for prior number of publications used only in the model that examines post award publications	IFRP Applicant Survey: C7	Continuous	Total pre-award publication

Exhibit C.6: Pre-Award Data Used To Construct Comparable Groups of IRFP Fellows and Unfunded Applicants for Impact Models

Covariate	Reason for Inclusion in Impact Model	Data Source(s)	Type	Definition
Field of study	Control for applicants field od study	IFRP Applicant Survey: A5	Dichotomous	1=Biological, agricultural, or environmental life sciences 0=All other disciplines 1=Physical and related sciences (includes Chemistry except biochemistry; earth, atmospheric, ocean sciences; physics) 0=All other disciplines 1=Computer and information sciences & Mathematics and statistics 0=All other disciplines 1=Psychology & social sciences &related science 0=All other disciplines 1=Engineering 0=All other disciplines 1=Health (non-STEM) 0=All other disciplines

Sensitivity Analysis

A series of sensitivity analyses were conducted to ensure that the impact results reported are reliable and robust. In particular, the following sensitivity analyses were conducted:

Using a different number of strata in the propensity score stratification

As a sensitivity analysis, propensity blocks were combined and the impact estimate was recalculated using impact model [1] above. Blocks 1 and 2 were combined (blocks with a small number of treatment group members relative to the number of comparison group members) and blocks 6 and 7 (blocks with a small number of comparison group members relative to the number of treatment group members).

Check sensitivity to matching method used

Stratification (also called interval matching) was the primary method for matching fellows and unfunded applicants. To check the sensitivity of the estimate to the matching method used, impacts were also estimated using the following propensity score matching methods: one-to-one (1:1), K-to-one (3:1), and radius (caliper) matching.[18] In its simplest form, 1:1 matching selects for each treated individual(s) the control individual with the closest propensity score (matching each fellow(s) with the most similar non-fellow). K:1 and radius matching improves on 1:1 matching by restricting the distance of the matches. All of the matches are then pooled into matched treated and control groups and analyses were run using groups as a whole rather than as individual matched pairs. These methods discard treatment/comparison cases without matches which could potentially lead to a reduction in power[19] but could lead to higher precision. For the K:1 and radius matching weights were used in the analysis to represent the pairing. The following model was then used to estimate the impact for this matching method:

$$[10]\ Y = \beta_0 + \beta_1(T_i) + \sum_{n=1}^{N} \beta_{n+1} X_i^n + \varepsilon_i$$

Where:

Y_i is the outcome of interest for individual i,

T_i is the treatment indicator for individual i (1=awardee , 0=non-awardee),

X_i^n is the n^{th} (n=1,2,…,N) covariate for individual i (such as gender, age, etc.) that are grand-mean centered, and

[18] For the radius match a caliper of 0.005 was used.

[19] The reduction in power is minimal, for two reasons. First, in a two sample comparison of means, the precision is largely driven by the smaller group size (Cohen, 1988). So if the treatment groups stays the same size and only the control group decreases size, the overall power may not actually be reduced very much (Ho et al., 2007). Second, the power increases when the groups are more similar because of the reduced extrapolation and higher precision that is obtained when comparing groups that are similar versus groups that are different. Snedecor, G. W. and Cochran, W. G. 1980. Statistical Methods, 7th ed. Iowa State Univ. Press, Ames, IA. MR0614143.

ε_i is the usual error term for individual i.

$\hat{\beta}_0$ is the covariate-adjusted mean value of the outcome for the non-awardees,

$\hat{\beta}_1$ is the overall impact estimate (i.e. the difference between the mean value of the outcome of the awardees and non-awardees),

$\hat{\beta}_0 + \hat{\beta}_1$ is the covariate-adjusted mean value of the outcome for the awardees, and

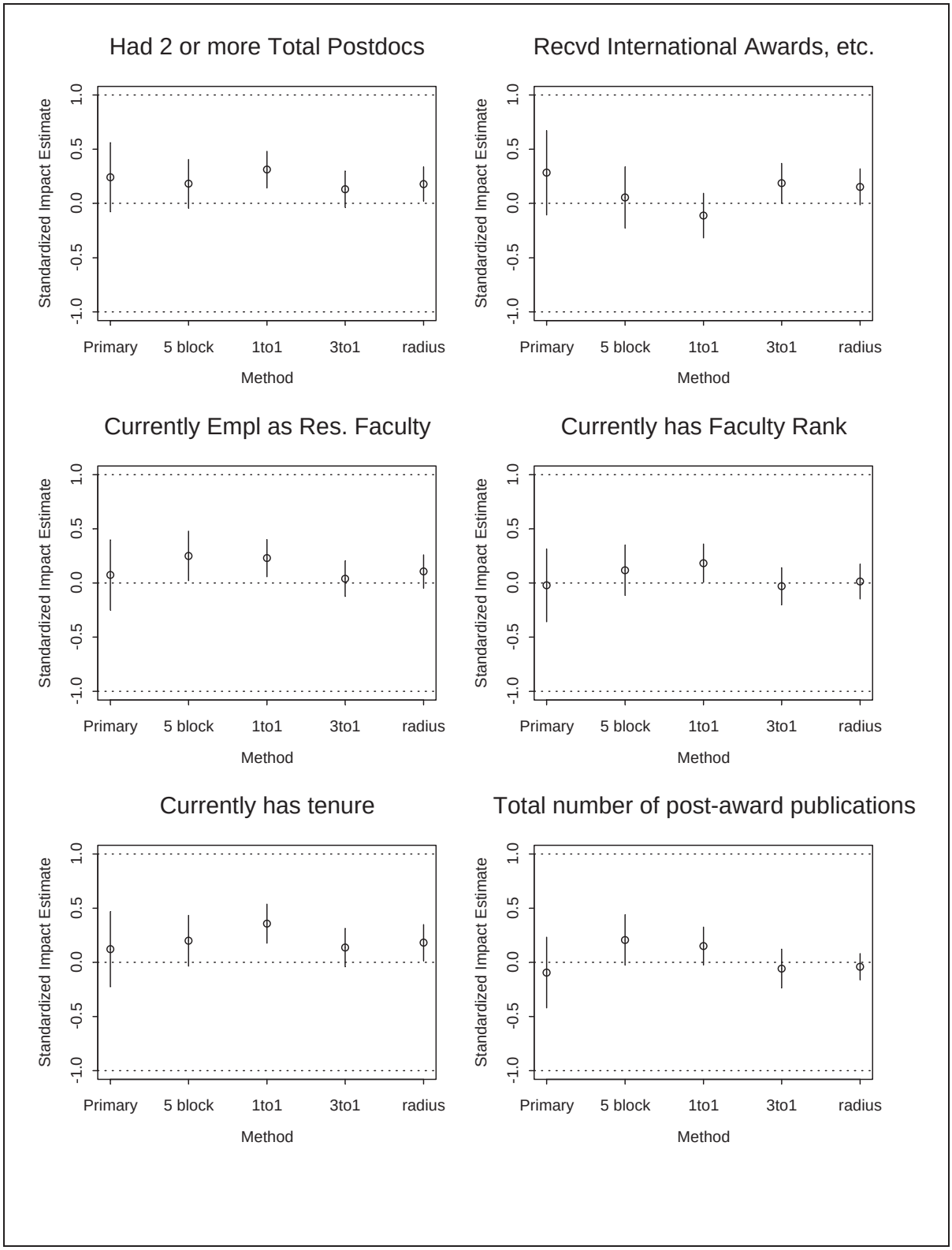
$\hat{\beta}_{n+(b-1)}$ (n=1,2,…,N) is the estimated overall relationship between the n^{th} covariate and the outcome controlling for other covariates.

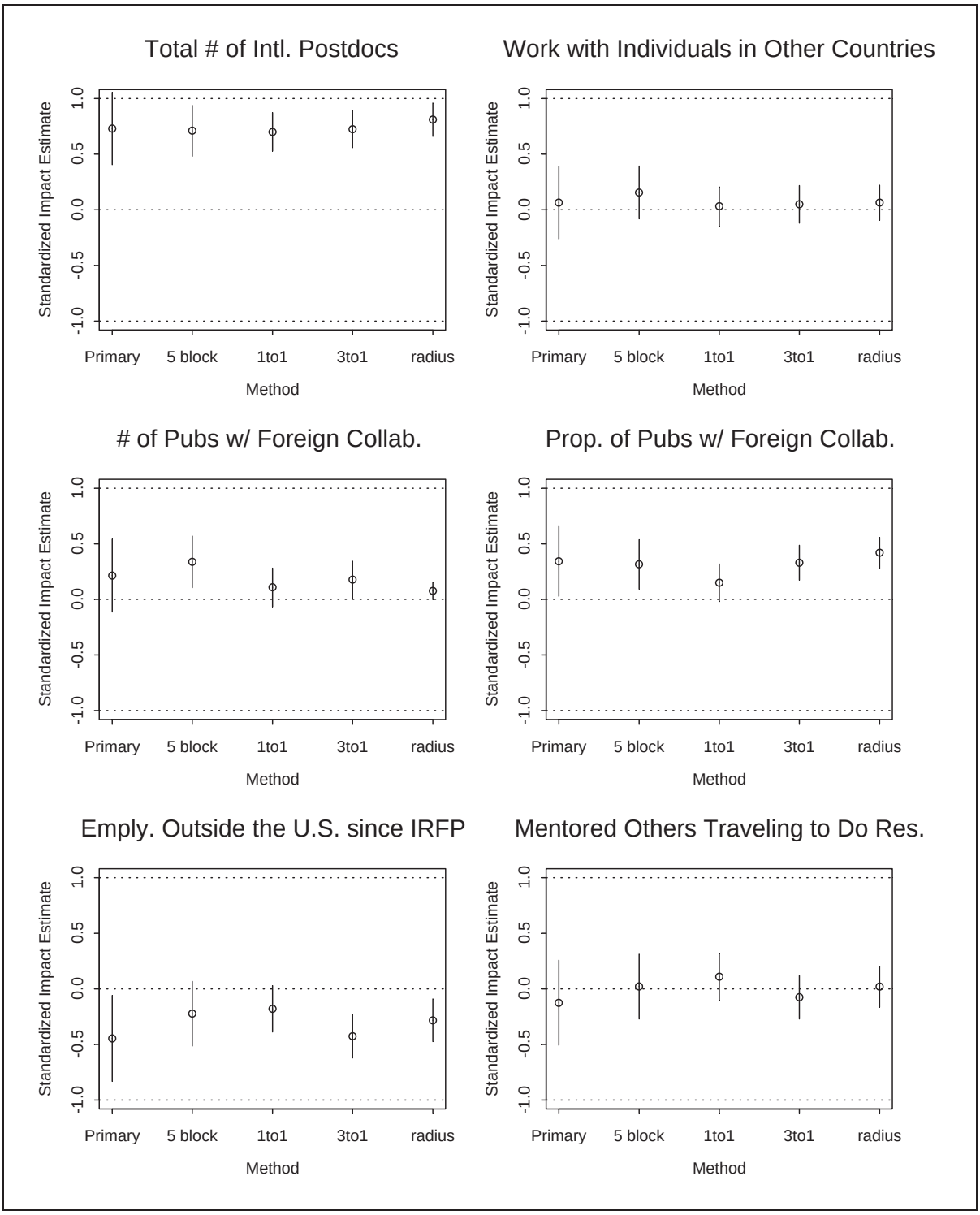
Sensitivity Checks Conclusion

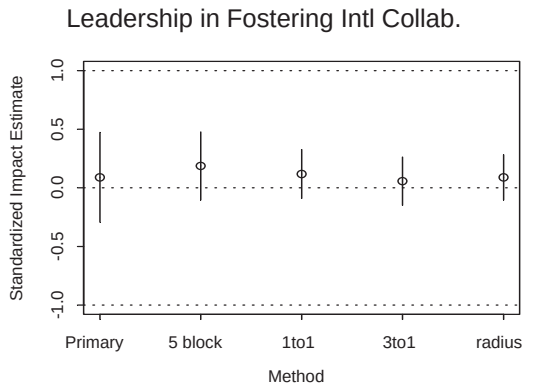
Sensitivity checks were conducted to determine how confident one could be with the results from the primary method of matching, i.e., to determine how sensitive the findings are to the different matching methods used.

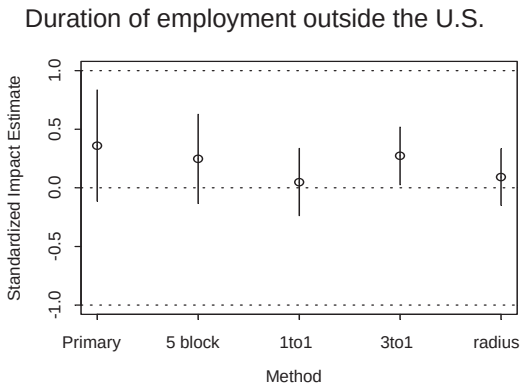
Exhibit C.7 shows the overall standardized impact estimate and a 95 percent confidence interval for the estimate for each of the outcomes from the primary method of matching. It also shows the estimate and 95 percent confidence interval for the impact estimate for each of the outcomes for the other matching techniques. This exhibit shows that while the impact estimates are robust (i.e. they are the same across matching methods) the estimates from the primary matching method are sometimes less precise (larger confidence intervals) then the estimates from other matching techniques. This is due to larger standard errors that occur because of the imbalance in the number of treatment and control members in some of the matched blocks in the primary method. Results from the 5-block method are reported since this method is similar to the primary method and increases precision. Precision is improved in the 5-block method because the balance in the number of treatment and control members in the matched blocks is improved.

Exhibit C.7: Overall Impact Estimates and Estimates with Each Sensitivity Analysis




Total # of Intl. Postdocs
Work with Individuals in Other Countries
# of Pubs w/ Foreign Collab.
Prop. of Pubs w/ Foreign Collab.
Emply. Outside the U.S. since IRFP
Mentored Others Traveling to Do Res.
Standardized Impact Estimate
1.0
0.5
0.0
-0.5
-1.0
Primary
5 block
1to1
3to1
radius
Method





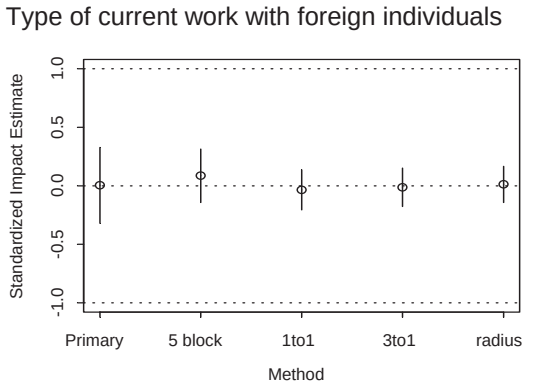


EXHIBIT SHOWS: On the far left of each graph, the impact estimate and 95% confidence interval is shown for the primary matching method (stratification). Moving from left to right, the graphs show the impact estimate and 95% confidence interval for the different matching methods.
NOTE: If the circle is above the dashed line representing 0.0 then the treatment effect is positive, if below 0 then the treatment effect is negative. If the confidence interval does not include 0 then the finding is significant.

Appendix D: Detailed Description of Benchmarking Analysis

This appendix describes the methodology used to compare the IRFP applicants and awardees and applicants to those of a nationally-representative sample.

The 2006 and 2008 Survey of Doctoral Recipients (SDR) was utilized in this study to compare the IRFP fellows and applicants to those of a nationally-representative sample of science, engineering and health (SEH) doctoral degree recipients on key employment, postdoctoral appointment, and international collaboration variables.

For this study, the primary comparison group for IRFP fellows is a propensity-score matched sample of unfunded IRFP applicants. The SDR respondents were used as a secondary comparison group to assess how fellows' and all applicants' outcome indicators compare to national averages. SDR indicators most relevant to the study include employment sector and current position, and the nature and extent of collaboration with foreign researchers. For example, comparisons included the percentage of respondents employed by academic institutions in the sample of IRFP fellows and applicants versus the national samples (Question D2a in 2008 SDR).

Exhibit D.1 shows the applicant survey items that were designed to allow comparison of IRFP awardees to SDR respondents.

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
D1a	A38 SDR 2006	Since completing your first doctoral degree, how many post-docs, if any, have you held?[1]	**Number of postdocs** ****IRFP**** Var=number of postdocs (0,1,2,…) **** SDR**** If 'none' box checked then var=0; Else Var=number of postdocs (0,1,2,…) Report average number of postdocs. **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D1c	A1 SDR 2008	During the week of [reference week][2] were you working for pay or profit? (includes postdoctoral appointments)	**Working during reference week.** ****IRFP**** If D1c in (1,2) then var=1; If D1c in (3) then var=0; ****SDR**** If A1=1 then var=1; If A1=2 then var=0; Report percent answering 'Yes' (1). **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D2	A12 SDR 2008	Was your primary[3] employer during the week of [reference week] an educational institution?	****IRFP**** If D2=1 then var=1; If D2=2 then var=0; ****SDR**** If A12=1 then var=1; If A12=2 then var=0; Report percent answering 'Yes' (1). **Control Variables:** - The number of years between

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
			receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D3	A11 SDR 2008	Which one of the following best describes your primary employer during [reference week]? Self-Employed or a Business Owner Private Sector Local Government State Government U.S Federal Government U.S Military Other	**Employment Type:** ****IRFP**** Variables coded as: 1=Yes, 0=No Report percent answering 'Yes' (1) to the following positions: - Self-Employed or a Business Owner If D2=0 and D3=1 then var=1; 0=else (note D2=1 is included in this else) - Private Sector If D2=0 and D3=2 then var=1; 0=else (note D2=1 is included in this else) - Local Government or State Government If D2=0 and D3 in (3,4) then var=1; 0=else (note D2=1 is included in this else) - U.S Federal Government or U.S Military If D2=0 and D3 in (5,6) then var=1; 0=else (note D2=1 is included in this else) - Other If D2=0 and D3 in (7) then var=1; 0=else (note D2=1 is included in this else) ****SDR**** Variables coded as: 1=Yes, 0=No Report percent answering 'Yes' (1) to the following positions: - Self-Employed or a Business Owner A11 in (1, 2) & A12=2 then var=1; A11 in (3, 4, 5, 6, 7, 8, 9) & A12=2 then var=0;

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
			- Private Sector A11 in (3, 4) & A12=2 then var=1; A11 in (1, 2, 5, 6, 7, 8, 9) & A12=2 then var=0; - Local Government A11 in (5, 6) & A12=2 then var=1; A11 in (3, 4, 1, 2, 7, 8, 9) & A12=2 then var=0; - U.S Federal Government or U.S Military A11 in (7, 8) & A12=2 then var=1; A11 in (3, 4, 1, 2, 5, 6, 9) & A12=2 then var=0; - Other A11 in (9) & A12=2 then var=1; A11 in (3, 4, 1, 2, 7, 8, 9, 5, 6) & A12=2 then var=0;
D2a[4]	A13[4] SDR 2008	Currently employed as research faculty at 4-year college/university, medical school, or university-affiliated research	**Currently employed at:** ****IRFP**** If D2a in (3,4,5) then var=1 If D2a in (1,2,6) then var=0 ****SDR**** If A13 in (3,4,5) then var=1 If A13 in (1,2,6) then var=0 Report percent answering 'Yes' (1). **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D2b[5]	A14[5] SDR 2008	During the week of [reference week] what type of academic position did you hold at this institution?[6] President, Provost, or Chancellor (any level) Dean (any level), department head or chair Research faculty, scientist,	**Academic Position** Variables coded as: 1=Yes, 0=No Report percent answering 'Yes' (1) to the following positions: President, Provost, or Chancellor (any level) Dean (any level), department head or chair

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
		associate or fellow Teaching faculty Adjunct faculty Other (please specify):	Research faculty, scientist, associate or fellow Teaching faculty Adjunct faculty Other (please specify) **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D2c[5]	A15[5] SDR 2008	Currently has faculty rank of Assistant, Associate or Full Professor	**Faculty Rank:** **IRFP** If D2c in (3,4,5) then var=1 If D2c in (6,7,8) then var=0 **SDR** If A15 in (3,4,5) then var=1 If A15 in (6,7,8) then var=0 Report percent answering 'Yes' (1). **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender.
D2d[5]	A16[5] SDR 2008	What was your tenure status?	**Tenure Status:** **IRFP** If D2d=3 then var=1 If D2d in (4,5) then var=0 **SDR** If A16=3 then var=1 If A16 in (4,5) then var=0 Report percent answering 'Yes' (1). **Control Variables:**

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
			- The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D4	A27, Item 4 SDR 2006	In performing the primary job you held during the week of [reference week], did you work with individuals located in countries other than the US?	**Work with individuals outside of US** Variable coded as 1=Yes, 0=No Report percent answering "yes" Report percent answering 'Yes' (1). **Control Variables:** - The number of years between receipt of first PhD degree and the reporting year of outcomes - Field of study for the first PhD - URM - Gender
D6, item 1	C1, Item 2 SDR 2008	IRFP: Peer-reviewed Journal articles SDR: Articles, (co)authored by you, have been accepted for publication in a refereed professional journal?	**Number of journal articles published** **IRFP** Var=number of articles(0,1,2,…..) **SDR** Var=number of articles(0,1,2,….) **Control Variables:** - Field of study for the first PhD - URM - Gender - IRFP only: The number of years between application to IRFP and survey reference date. Everyone in the SDR sample reported publication in the last 5 years this was not a control.
D6, item 2	C1, item 1 SDR 2008	IRFP: Peer-reviewed conference publications (e.g. abstracts, conference papers, posters) SDR: Papers have you (co)authored for presentation at regional, national or international conferences? *(Do not count presentations of the*	**Number of conference publications** **IRFP** Var=number of conference publications(0,1,2,…..) **SDR** Var=number of conference publications(0,1,2,…..) Report percent answering 'Yes' (1).

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR
		same work more than once.)	**Control Variables:** - Field of study for the first PhD - URM - Gender - IRFP only: The number of years between application to IRFP and survey reference date. Everyone in the SDR sample reported publication in the last 5 years so this was not a control.
D6, item 3	C2, C3, item 1 and 2 SDR 2008	IRFP: Patents, registered or pending SDR: Since October 2003, have you been named as an inventor on any application for a U.S. patent? or How many applications for U.S. patents have named you as an inventor? or How many U.S. patents have been granted to you as an inventor?	**Number of patents** **IRFP** Var=number of patents(0,1,2,.....) **SDR** If C2=2 then var=0 Else Var=sum(C3.1:C3.2) **Control Variables:** - Field of study for the first PhD - URM - Gender - IRFP only: The number of years between application to IRFP and survey reference date. Everyone in the SDR sample reported publication in the last 5 years so this was not a control.
D6, item 4	C1, item 3 SDR 2008	IRFP: Book Chapter(s) SDR: Books or monographs, (co)authored by you, have been published or accepted for publication?	**Number of book chapter(s)** **IRFP** Var=number of chapters(0,1,2,.....) **SDR** Var=number of chapters(0,1,2,.....) **Control Variables:** - Field of study for the first PhD - URM - Gender - IRFP only: The number of years between application to IRFP and survey reference date. Everyone in the SDR sample reported publication in the last 5 years so this was not a control.

Exhibit D.1: IRFP Applicant Survey Items Comparable to Items on the 2006 Survey of Doctoral Recipients

IRFP Applicant Survey Item	SDR Item	Item text	SDR

NOTES:

1 The wording for this question is slightly different between IRFP and SDR. IRFP is: Since receiving your first doctoral degree how many postdoctoral appointments have you held? Please include any postdocs you held through October 1, 2010. SDR is: Since completing your first doctoral degree, how many "postdocs," if any, have you held? Please include any postdocs you held through April 1, 2006.

2 The reference week for the 2008 SDR was October 1, 2008; for the IRFP applicant survey, October 1, 2010.

3 The IRFP question asks about primary employer and SDR asks about principle employer.

4 For IRFP, D2a is presented only if D2=Yes. For the 2006 SDR, Item A13 applies only if A12=Yes.

5 For IRFP, this item is only presented if D2=Yes and D2a not equal to preschool, elementary, middle, secondary school; for the 2006 SDR, this item applies only if A12=yes and A13 not equal to preschool, elementary, middle, secondary school

6 Items have different response options. In IRFP Research Assistant, Teaching Assistant, and Postdoc were collapsed into "other." Postdocs would skip out of D2b, so IFRP did not have options for Research Assistant, or Teaching Assistant. For the SDR data Research Assistant, Teaching Assistant were grouped into the Other category.

Limitations of These Comparisons

There were four noteworthy limitations of these data. First, the SDR survey was not designed to measure many of the outcomes that are pertinent to this study. Research productivity, for example, is a particularly notable omission. The use of the SDR as a national comparison is limited to the subset of items such as current employment, number of international collaborations, and a few others.

The second limitation of the SDR data is the difference in timing, as this study collected data in 2011, whereas the SDR data come from surveys administered in 2006 and 2008. As a result, when the year of first doctoral degree attainment was used as a variable on which to compare the study population to the SDR population, the groups are out of phase by two to five years, depending on the SDR cycle. For example, 2006 SDR respondents who earned their PhDs in 2000 would have had six years to achieve their outcomes by the time of the data collection. In contrast, respondents to the IRFP survey who earned their PhD in the same year (2000) would have had 11 years to achieve outcomes, possibly biasing any comparison of the two groups. To mitigate this problem, comparisons controlled for the number of years between the receipt of first PhD degree and the reporting year of outcomes in the analyses.

The third limitation is that the sampling frame for the SDR excludes individuals living outside of the United States during the survey reference period. This methodology creates a sample bias relevant to the IRFP program. The sampling bias is compounded in that individuals excluded from the initial SDR would be excluded from any subsequent follow-up SDR surveys. As a result, the SDR sample might include fewer individuals likely to be engaged in international research collaboration.

Finally, the SDR sample has the potential to include some IRFP recipients. It was not possible to obtain personal identifying information for SDR respondents, so IRFP participants could not be removed from the SDR sample. The 2006 SDR sample consisted of 30,817 individuals. The 2008 SDR

sample consisted of 29,974 individuals. Since there are only 457 IRP awardees in the sample, the potential overlap is very small (<1 percent), hence these were treated as independent samples.

Performing the Calculations

The goal of the benchmarking calculation was perform a test of whether the difference between the two adjusted means from the two samples is equal to zero. Exhibit D.2 shows a specification of the hypothesis test and the method for calculating the p-value from the test is shown. Exhibit D.3 shows a method for calculating the variance (and standard error) of the difference of the means and Exhibit D.4 shows a method for calculating the variance (and standard error) of the difference of the proportions.[20]

Exhibit D.2: Hypothesis Testing

Let $\bar{x}_1$ denote the estimated mean from the IFRP sample of size n_1.

$\bar{x}_2$ denote the mean from the SDR sample of size n_2.

$SE(\bar{x}_2 - \bar{x}_1)$ denote the standard error of the difference between the two sample means.

$$H_o : \bar{x}_1 - \bar{x}_2 = 0 \quad vs \quad H_a : \bar{x}_1 - \bar{x}_2 \neq 0$$

Test Statistic is:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{SE(\bar{x}_1 - \bar{x}_2)}$$

If the observed value of *t* as calculated above is greater than the critical value from the t-distribution with n –2 degrees of freedom and α=0.05, the null hypothesis will be rejected at the p<0.05 level.

OR

Let p_1 denote the estimated proportion from the IFRP sample of size n_1.

p_2 denote the estimated proportion from the SDR sample of size n_2.

$SE(p_1 - p_2)$ denote the standard error of the difference between the two sample proportion.

$$H_o : p_1 - p_2 = 0 \quad vs \quad H_a : p_1 - p_2 \neq 0$$

Let the *z* be the standardized deviate, calculated as:

$$z = \frac{(p_1 - p_2) - 0}{SE(p_1 - p_2)}$$

Compare *z* to the quantiles of a standard normal distribution, N(0,1), to find the two-sided probability of obtaining a deviate with absolute value that is as large or larger than *z*. If the absolute value of *z* is greater than 1.96, the null hypothesis will be rejected at the p<0.05 level.

[20] Kish, L. 1995. *Survey sampling.* New York: Wiley.

Exhibit D.3. Estimating the Variance of the Difference in Two Sample Means

Let $\bar{x}_1$ denote the estimated mean from the IFRP sample of size n_1. Let $\bar{x}_2$ denote the mean from the SDR sample of size n_2. The difference between the two sample means was tested. The estimated variance of the difference between the two sample mean is written as

$$v(\bar{x}_1 - \bar{x}_2) = v(\bar{x}_1) + v(\bar{x}_2) - 2\,\mathrm{cov}(\bar{x}_1, \bar{x}_2)$$

Under simple random sampling, the variance of the difference can be written as

$$v(\bar{x}_1 - \bar{x}_2) = v(\bar{x}_1) + v(\bar{x}_2) - \frac{2\rho_{x_1x_2}\, m\sqrt{v(\bar{x}_1)v(\bar{x}_2)}}{\sqrt{n_1 n_2}}$$

$v(\bar{x}_1)$ is the estimated variance of the mean based on the IRFP sample of n_1 units, $v(\bar{x}_2)$ is the estimated variance of the SDR mean based on n_2 units and m is the amount of overlap between the two samples. The correlation ($\rho_{x_1x_2}$) is estimated based on the overlap. Since m is almost 0 the variance can be estimated as:

$$v(\bar{x}_1 - \bar{x}_2) = v(\bar{x}_1) + v(\bar{x}_2)$$

The variance under the sample[21] design is obtained from proc survey reg for the first mean and the second mean. The square root of the variance gives the standard error of the difference in the two means, which can be used in a statistical test.

[21] The IRFP was treated as a simple random sample or "pseudo-sample" since awardees from a different grant period might result in a different estimate.

Exhibit D.4: Estimating the Variance of the Difference in Two Sample Proportions Based on Independent[22] Samples.

Let p_1 denote the estimated proportion from the IFRP sample of size n_1. Let p_2 denote the proportion from the SDR sample of size n_2. The difference between the two sample means was tested. The estimated variance of the difference between the two sample mean is written as

$$v(p_1 - p_2) = v(p_1) + v(p_2) - 2m\mathrm{cov}(p_1, p_2),$$

Since m is almost 0 one can write the estimated variance of the difference between the two proportions as:

$$v(p_1 - p_2) = v(p_1) + v(p_2)$$

One can get the variance under the sample[23] design from proc survey reg for the first proportion and the second proportion. The square root of the variance gives the standard error of the difference in the two means, which can be used in a statistical test.

Estimation of Mean and Variance

As mentioned above SAS proc survey reg was used to obtain the adjusted mean and standard error. The following regression model was used to estimate the adjusted mean and standard error for each sample:

$$Y_i = \beta_0 + \sum_{n=1}^{N} \beta_n X_i^n + \varepsilon_i$$

Where:

Y_i is the outcome of interest for individual i,

X_i^n is the n^{th} (n=1,2,…,N) covariate for individual i (such as gender, URM, number of years between PHD and survey date, etc.) that are grand-mean centered across the samples, and

ε_i is the usual error term for individual i.

Interpretation of Parameters

Interpretation of the coefficients in the model is as follows:

[22] The IRFP sample is a potentially a ***very*** small proportion (close to 0) of the SDR sample so these were treated as independent samples.

[23] The IRFP is treated as a simple random sample as "pseudo-sample" since awardees from a different grant period might produce a different estimate.

$\hat{\beta}_0$ is the covariate-adjusted mean value of the outcome for the sample,

$\hat{\beta}_n$ (n=1,2,…,N) is the estimated overall relationship between the n^{th} covariate and the outcome controlling for other covariates.

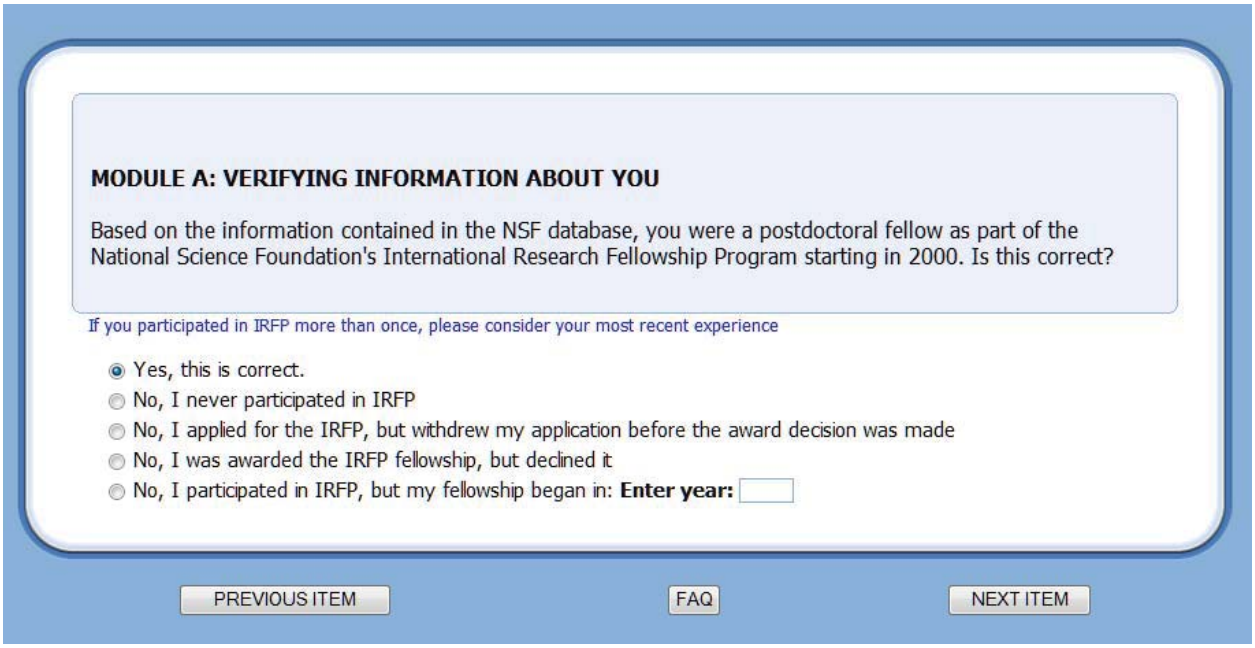
Appendix E: Surveys

International Research Fellowship Program (IRFP)

Applicant Survey Items

Programming notes appear in red or brown text throughout.
Hyperlinked text will appear embossed and underlined in this document but should not be formatted this way onscreen unless noted (underlining is fine except for email addresses, but embossing is not).

General guidelines:
Each screen displayed one question at a time unless otherwise indicated.
Each screen displayed a standard set of Navigaton buttons shown below.



Some items contained placeholders for fields that were programmed to be auto-filled from the sample file for each respondent. These fields are enclosed in [brackets] and printed in brown. Some of these placeholders used internal (control) variables. For example, [year of application + 2] were calculated based on a sample field called [year of application]. If this field = 1999 for a respondent then the resulting auto-filled [year of application + 2] would equal 2001.

Textboxes for open-ended responses are indicated with [textbox, 150] where the number indicates the length of the field (how many characters the respondent may type).

REMINDERS for BLANK RESPONSES and DEFAULTS for SKIP PATTERNS if RESPONSE was MISSING

- No items required a response.
- No items required a reminder to enter an answer/select a response unless indicated below. If a reminder was needed for the first time user leaves an item blank, the item was re-displayed adding the text below shown on-screen in **bold, red text.**

These reminders and defaults are given at the end of this document.

Sample variables.

AwdStatus: **Fellow** or **Unfunded Applicant**: Two groups of respondents will be tracked using the sample file: Fellows, and Unfunded Applicants. In the sample file, Awardee = FELLOW and Declinee = UNFUNDED APPLICANT. The outcome of the most recent year of application for individuals with multiple IRFP applicants was used to determine Award Status (AwdStatus)

PI_Name will consist of **First Name, Middle Name, Last Name**. Note that Middle Name may be an initial or may be blank.

Phd_year: year in which respondent received his/her doctoral degree. If this field is blank or missing it should be auto-filled with the following text string: **Unknown**

Year of application: Indicates the cohort (year) in which the respondent applied for participation. Range: 1992 through 2009. The most recent year of application for individuals with multiple IRFP applicants was used.

IRFP country: The name of the nation where the respondent wanted to pursue the IRFP fellowship.

Introductory screen:

Survey of former applicants to the National Science Foundation's International Research Fellowship Program (IRFP)

Welcome and thank for your interest in this study. This survey is being conducted by Abt Associates Inc., and our subsidiary, AbtSRBI, for the National Science Foundation (NSF), to learn about individuals who applied to NSF's International Research Fellowship Program (IRFP) for a postdoctoral fellowship. This survey will give NSF information about the professional characteristics and international collaborations of U.S. scientists and engineers and help NSF improve programs intended to foster a globally engaged scientific and engineering workforce. You are receiving this survey because you are listed in the IRFP database as a former applicant to IRFP. We estimate that it will take approximately 30 minutes to complete the survey.

Confidentiality and Participation

Participation in the survey is voluntary and nonparticipation will have no impact on you or your institution. You may skip questions on the survey or discontinue participation at any time. There are minimal risks associated with your participation. We take your privacy very seriously. Your responses to this survey will be protected under the Privacy Act. There is minimal risk of breach of confidentiality, and we have put in place procedures to minimize this risk. Reports will never identify you by name, and information from the study will only be reported in the aggregate at the program level, combined with about 250 other responses. When we receive your survey we will detach and store separately your name and other identifying information that could be used to link you to your survey responses. Survey responses will be stored on a secure drive that is only accessible to members on the study team. Only study team web technicians and data analysts from Abt Associates and AbtSRBI will see individual responses that can be linked to you. Survey data files will be shared with NSF at the end of the study, only after study team members have examined the data to be free of any information that could help identify you; this cleaning includes procedures to limit someone from inferring your identity by analyzing non-identifying data. Hence, we encourage you to respond candidly about your experiences. Separate from your individual responses to the survey we will provide NSF any updated contact information we have found or requested from you. None of this contact information will be linked in any way to your survey responses. At the conclusion of the study, Abt Associates and AbtSRBI will destroy all records, electronic or otherwise, that link you to your survey responses.

Continue

This study's IRB approval number is #0494, valid from 8/6/2010 to 8/5/2011. For questions, please contact Teresa Doksum, IRB Administrator, Abt Associates, at IRB@abtassoc.com.

The valid OMB control no. for this information collection is 3145-0214. (Expires on 12/31/13)

Next screen:

IRFP applicant survey

Questions

If you have questions about the study, please contact the study director, Alina Martinez of Abt Associates Inc. at (866) 421-6223 (toll free within the U.S.) or email her at IRFP_survey@abtassoc.com. You may also contact the evaluation's program officer at NSF, John Tsapogas (jtsapoga@nsf.gov). If you have questions about your rights as a research participant, you may contact Teresa Doksum, the Abt Institutional Review Board Administrator at (877) 520-6835 (toll-free within the U.S.) or by email: irb@abtassoc.com. To learn more about this study, please refer to the Frequently Asked Questions page.

Navigating through the survey:

As you work through the survey, your responses are automatically saved. You may change a response by clicking on the PREVIOUS ITEM button. Use the NEXT ITEM button to advance to the next question. At any time, you may close your browser if you wish to return and finish at a later time. When you log back in, the survey will take you to where you left off. On each page of the survey, a FAQ button is provided if you have a question during the survey or need information about how to contact the survey administrator

When you have completed the survey, please click on the SUBMIT button at the end of the survey. You may submit the survey even if there are some questions that you choose not to answer.

Consent

Please click on "Begin" if you agree to participate in this study. BEGIN

FAQs are Optional screens, displayed only if R clicks on **Frequently Asked Questions**

FREQUENTLY ASKED QUESTIONS

What is the International Research Fellowship Program (IRFP)?

The International Research Fellowship Program (IRFP) is a National Science Foundation (NSF) program that provides support for new doctoral-level scientists and engineers to conduct research in a foreign country for a period of 3 to 24 months.

Why are you doing this study?

NSF is interested in learning about the characteristics of scientists and engineers who applied for an IRFP Fellowship between 1992 and 2009. Information about the domestic and international experiences of IRFP participants and non-participants will help NSF understand the usefulness and relevance of international research training for scientists and engineers. Information from this study will be used to describe the experiences and career paths of new Ph.D. scientists and engineers who expressed interest in pursuing an international collaboration.

Why have I been selected to participate in this survey?

You have been selected to participate because we have identified you as having applied to the International Research Fellowship Program (IRFP).

How did you get my contact information?

We identified you from records maintained by the National Science Foundation on prior IRFP applicants. We then obtained your contact information through an internet search.

How long will this survey take to complete?

We estimate that the survey will take about 30 minutes.

How will you use my comments?

Responses from all survey respondents will be used to answer questions about IRFP applicants' early career trajectories, the nature of their research collaborations both within and outside of the U.S., and their subsequent career paths.

Has this study been reviewed and approved by an institutional review board?

Yes, the study was also approved by Abt Associates' Institutional Review Board. If you have any concerns about your participation in this survey, please contact Teresa Doksum, Institutional Review Board Administrator at Abt Associates, at (877) 520-6835 or via email at irb@abtassoc.com.

Who is funding the study?

The study has been funded by the National Science Foundation under contract GS-10F-0086K. Abt Associates and AbtSRBI will complete the study.

Who are Abt Associates Inc and AbtSRBI?

Abt Associates is an independent research firm headquartered in Cambridge, Massachusetts. AbtSRBI is a wholly-owned subsidiary of Abt Associates specializing in large-scale data collection and public opinion research. NSF has contracted with Abt Associates and AbtSRBI to design and implement a survey of individuals who applied to NSF's International Research Fellowship Program (IRFP).

IRFP applicant survey

MODULE A: VERIFYING INFORMATION ABOUT YOU
To begin, we'd like to confirm that we've reached the appropriate person.

A1. Based on the information that you provided to NSF in your application, your name is [First Name, Middle Name/initial, Last Name]. Is this correct?

- ❑ No, my name has changed or my name is misspelled above. My name is: [textbox, 75]
- ❑ No, I'm not the person named above. → **EXIT SCREEN**
- ❑ Yes, this is correct.

[Former IRFP fellows only]

A2.1. Based on the information contained in the NSF database, you were a postdoctoral fellow as part of the National Science Foundation's International Research Fellowship Program starting in [**Year of application**]. Is this correct? *If you participated in IRFP more than once, please consider your most recent experience*

- ❑ Yes, this is correct. → **GO TO A3**
- ❑ No, I never participated in IRFP → **GO TO CONFIRM FELLOWSHIP SCREEN**
- ❑ No, I applied for the IRFP, but withdrew my application before the award decision was made → **GO TO EXIT SCREEN**
- ❑ No, I was awarded the IRFP fellowship, but declined it → **GO TO EXIT SCREEN**
- ❑ No, I participated in IRFP, but my fellowship began in:

Enter year: [textbox, 4] → **GO TO A3 [Prompt R to correct entry: "Please type a four-digit year between 1990 and 2010"] Set Year of application = entered year.**

[Unfunded IRFP applicants only]

A2.2. Based on the information contained in the NSF database, you applied to the National Science Foundation's International Research Fellows Program (IRFP) for a [year of application] postdoctoral fellowship, but did not participate in an IRFP fellowship. Is that correct? ***The year shown is the year in which the fellowship was to begin, not the application deadline.***

- ❑ Yes, this is correct.→ **GO TO A3**
- ❑ No, I applied for an IRFP fellowship to begin in (**Enter year**): [textbox 4] [**Prompt R to correct entry: "Please type a four-digit year between 1990 and 2010"] Set Year of application = entered year.**
- ❑ No, I did participate in an IRFP fellowship. → **GO TO CONFIRM FELLOWSHIP SCREEN**
- ❑ No, I never applied for this program. → **GO TO CONFIRM FELLOWSHIP SCREEN**

A3. Based on the information in the NSF database, you applied to spend your IRFP fellowship in [**IRFP country**]. Is this correct?

- ❑ Yes
- ❑ No, I applied for an IRFP fellowship in (**Enter country):** [textbox, 50]. **Set IRFP_country = entered country**

A4a. Our records indicate that you received your doctorate in [**phdyear**]. Is this correct?

- ❑ Yes, this is correct. → **GO TO A5**
- ❑ No, I earned my degree in (**Enter year**): [textbox, 4] → **GO TO A5 Prompt R to correct entry: "Please type a four-digit year between 1990 and 2010"] Set phdyear = entered year**
- ❑ I have more than one doctorate. →**GO TO A4b**

A4b. Please enter the years that you received your first and your most recent doctoral degrees:
First doctoral degree received in (enter year): [textbox, 4]
Most recent doctoral degree (enter year): [textbox 4]

A5. What discipline best characterizes your field of research when you applied for an IRFP fellowship (that is, your doctoral field of research)? First, indicate which one of four broader areas in which your discipline falls:
Check one only:

- ❑$_1$ Sciences (Biological/Life, Chemical, Computer/Information, Environmental, Earth/Atmospheric/Oceanographic, Geosciences, Mathematical/Statistical, Physics, Psychology)
- ❑$_2$ Social Sciences (Economics, Sociology, Anthropology/Archaelogy, Political Science, Geography, Linguistics, other)
- ❑$_3$ Health/Medical
- ❑$_4$ Engineering

display one of three screens based on choice above:
1 Science screen
2 Social Science, Health screen
3 Social Science, Health screen
4 Engineering screen
After R hits SUBMIT, go to Item B1

Science Fields

For Science/Math Education select the primary scientific or mathematical field, or select Social Sciences or Health/Medical and see "OTHER Social Sciences: Education, General"

To view other fields (Social Science, Health/Medical, Engineering), please select Go back to the 4 broad categories to change your selection.

Agricultural/food sciences	❍ Animal sciences ❍ Food sciences/technology	❍ Plant sciences ❍ OTHER agricultural sciences
Biological sciences *Bioengineering, see ENGINEERING, next page*	❍ Biochemistry/biophysics ❍ Biology, general ❍ Botany ❍ Cell/molecular biology ❍ Ecology ❍ Genetics, animal/plant	❍ Microbiological sciences/immunology ❍ Nutritional sciences ❍ Pharmacology, human/animal ❍ Physiology and pathology, human/animal ❍ Zoology, general ❍ OTHER Biological sciences
Environmental life sciences	❍ Environmental science/studies	❍ Forestry sciences
Computer and information sciences *For Computer Engineering, see ENGINEERING, next page*	❍ Computer/information sciences, general ❍ Computer programming ❍ Computer science	❍ Computer systems analysis ❍ Information services/systems ❍ OTHER computer/information sciences
Mathematics and statistics	❍ Applied mathematics ❍ Mathematics, general ❍ Operations research	❍ Statistics ❍ OTHER mathematics
Chemistry, except biochem	❍ Chemistry except biochemistry (*biochemistry, see Biological sciences*)	
Earth, atmospheric, and ocean sciences	❍ Atmospheric sciences/meteorology ❍ Earth sciences ❍ Geology	❍ Geological sciences, other ❍ Oceanography ❍ OTHER physical sciences
Physics *Biophysics, see Biological Sciences*	❍ Astronomy/astrophysics	❍ Physics
Psychology	❍ Clinical psychology ❍ Counseling ❍ Educational psychology ❍ Experimental psychology	❍ General psychology ❍ Industrial/organizational psychology ❍ Social psychology ❍ OTHER psychology

SUBMIT

GO BACK TO 4 BROAD CATEGORIES

Social Sciences and Health/Medical fields

For Science/Math Education select the primary scientific or mathematical field (click on Science), or see below "OTHER Social Sciences: Education, General"

To view other fields (Science, Engineering), please select Go back to the 4 broad categories to change your selection.

Economics	❍ Agricultural economics	❍ Economics
Political and related sciences	❍ International relations ❍ Political science/government	❍ Public policy studies
Sociology/Anthropology	❍ Anthropology/archaeology ❍ Criminology	❍ Sociology
OTHER social sciences	❍ Area/ethnic studies ❍ Education, general ❍ Geography ❍ History of science	❍ Linguistics ❍ Philosophy of science ❍ OTHER social sciences
Health	❍ Audiology/speech pathology ❍ Health services administration ❍ Health/medical assistants ❍ Health/medical technologies ❍ Medical preparatory programs (e.g., pre-dentistry, pre-medical, pre- veterinary) ❍ Medicine (e.g., general, internal, orthopedic, surgical, dentistry, optometry, osteopathic, podiatry, veterinary)	❍ Nursing (4 years or longer program) ❍ Pharmacy ❍ Physical therapy and other rehabilitation/therapeutic services ❍ Public health (Including environmental health/epidemiology) ❍ OTHER health/medical sciences

SUBMIT

GO BACK TO 4 BROADER CATEGORIES

Engineering fields

For Science, Math or Engineering Education select the primary scientific or mathematical field (click on Science), or or select Social Sciences or Health/Medical and see "OTHER Social Sciences: Education, General"

To view other fields (Science, Social Science, Health/Medical), please select Go back to the 4 broad categories to change your selection.

Biochemical engineering, *see Bioengineering/biomedical under OTHER Engineering*		
Chemical engineering	❍ Chemical engineering	
Civil/architectural eng.	❍ Architectural engineering	❍ Civil engineering
Electrical/computer engineering	❍ Computer/systems engineering	❍ Electrical/electronics/communications engineering
Industrial engineering	❍ Industrial/manufacturing engineering	
Mechanical engineering	❍ Mechanical engineering	
OTHER engineering	❍ Aerospace/aeronautical/ astronautical engineering ❍ Agricultural engineering ❍ Bioengineering/biomedical engineering ❍ Engineering, general ❍ Engineering sciences/ mechanics/physics ❍ Environmental engineering	❍ Geophysical/geological engineering ❍ Materials engineering, including ceramics/textiles ❍ Metallurgical engineering ❍ Mining/minerals engineering ❍ Naval architecture/marine engineering ❍ Nuclear engineering ❍ Petroleum engineering ❍ OTHER engineering

SUBMIT

GO BACK TO 4 BROAD CATEGORIES

MODULE B: THE IRFP APPLICATION PROCESS

B1. Why did you apply to IRFP? *Check all that apply*.

- ❑ To conduct research with a specific person or at a specific institution
- ❑ To collaborate with a foreign scientist
- ❑ To understand what research in my field was like outside the US
- ❑ To access resources (e.g. samples, equipment) for research that I could not find in the U.S.
- ❑ To enhance my skills or knowledge as a researcher
- ❑ To enhance my resume as a future job candidate
- ❑ To learn about the culture, history, and/or geography of another country
- ❑ To learn another language
- ❑ To travel outside of the United States
- ❑ For family reasons (e.g., to accompany a spouse traveling abroad)
- ❑ Other (please specify): [textbox, 300]

B2. For your application to the IRFP program, why did you select your IRFP country? *Check all that apply.*

- ❑ The host researcher was conducting research relevant to my own interests
- ❑ The host institution had equipment or resources helpful for my proposed research
- ❑ A faculty advisor or mentor recommended this particular country, the particular host institution or host researcher in this country
- ❑ I have professional ties with someone who is from this country
- ❑ The host researcher had visited my department or university
- ❑ There were particular places in this country (aside from the host institution) that I wanted to visit or see
- ❑ I had studied this country's culture, history, politics, geography, etc. before applying
- ❑ I was familiar with the primary language(s) spoken there
- ❑ Other reason (please specify): [textbox, 300]

B3. Did the notification of your application status allow you sufficient time to make the necessary arrangements for your visit or to make alternative plans if you did not receive the award? *Check one only.*

- ❑ Yes
- ❑ No

B4. How did your primary graduate advisor view your decision to apply for an IRFP? *Check one only.*

- ❑ I do not know how my advisor viewed my decision to apply
- ❑ I did not have an advisor when I most recently applied
- ❑ My advisor opposed my decision to apply
- ❑ My advisor was indifferent to my decision to apply
- ❑ My advisor supported my decision to apply
- ❑ My advisor encourage me to apply to the IRFP program

B5. What types of mentoring or guidance did you receive from your graduate advisor or other colleagues during the preparation of the IRFP application? *Check all that apply.*

- ❑ Suggested a host institution
- ❑ Recommended me to a colleague at the host institution
- ❑ Provided feedback on my project proposal
- ❑ Discussed with me cultural and language aspects of the host country
- ❑ Other – specify: [textbox, 300]
- ❑ None

MODULE C: ABOUT YOU AT THE TIME OF YOUR APPLICATION
Items in this section ask for information about the year in which you applied for an IRFP Fellowship.

C1. At the time you applied for an IRFP Fellowship ([year_of_application]) were you employed in a tenure-track faculty position? *Check one only*

- ❑ Yes
- ❑ No

C2a. At the time you applied for IRFP ([year_of_application]), what was the highest degree you had completed? *You may have applied before you officially received your doctorate, for example. Check one only:*

- ❑ Bachelor's degree (BS, BA)
- ❑ Master's degree (MA, MS, MBA, etc.)
- ❑ Doctoral degree (PhD, EdD, MD, joint MD/PhD, JD, PsyD, ScD)
- ❑ Other degree– specify: [textbox, 50] no entry req'd in textbox

C2b. At the time you applied for IRFP ([year_of_application]), had you received or were you pursuing a graduate degree from an institution outside the United States? *Check one only*

- ❑ Yes
- ❑ No

C3a. While you were an undergraduate, did you participate in a study abroad program or did you spend a semester (or more) pursuing your education at a college/university outside the United States? *Check one only*

- ❑ Yes
- ❑ No

C3b. While you were a graduate student did you participate in a study abroad program or did you spend a semester (or more) pursuing your graduate research or education outside the United States? *Check one only*

- ❑ Yes
- ❑ No

C4. At the time you applied for IRFP ([year_of_application]), had you done any of the following? *Check all that apply*

- ❑ Attended elementary or secondary school in another country (outside the U.S.)
- ❑ Lived outside the U.S. for six months or longer
- ❑ Collaborated on research with someone based in another country
- ❑ Published research with someone based in another country
- ❑ Attended or presented scholarly work at a research conference in another country
- ❑ Participated on a research team with a scientist who was visiting my group from a foreign institution
- ❑ Worked with a colleague who had completed an IRFP Fellowship
- ❑ None of the above

C5a. At the time you applied for an IRFP fellowship ([year_of_application]), were you already working at the foreign institution that you proposed as your IRFP host? *Check one only*

- ❑ Yes
- ❑ No

C5b. At the time you applied for IRFP ([year_of_application]), were you already collaborating with the host scientist(s) or someone else at the host institution(s) that you proposed in your application? *That is,even if you were not physically working at the host institution, were you already collaborating with someone at that institution? Check one only*

- ❑ Yes, with my proposed host scientist
- ❑ Yes, with someone else at my proposed host institution (not the host scientist)
- ❑ No

C6. At the time you applied for an IRFP Fellowship ([year_of_application]) were you aware of any relationship between your U.S.-based institution (graduate, postdoctoral, or other) and that of the host institution to which you applied? *Check all that apply:*

- ❑ Yes, a student, postdoc or faculty member in my department had collaborated with someone at the host institution
- ❑ Yes, my department or university had an existing collaboration or student/faculty exchange program with the host institution
- ❑ Other students/postdocs/faculty from my university or department had been to the host institution
- ❑ Yes, there was another type of relationship. Please specify: [textbox, 300] no entry req'd in textbox
- ❑ No, I was not aware of any such relationship

C7. At the time you applied for the IRFP ([year_of_application]), how many of the following had you authored/co-authored, edited/co-edited, developed/co-developed? *Include works in press but do not include works "under review" or "in preparation." Include works published in electronic or printed format but do not count the same work more than once if it is available in multiple formats.*

Total number published/in-press	Number completed with a foreign collaborator	
		Peer-reviewed journal articles
		Peer-reviewed conference publications (e.g. abstracts, conference papers, posters)
		Patents, registered or pending
		Book chapter(s) (e.g., in edited volumes)

C8. Have you ever received a nationally competitive fellowship to support your graduate studies? *Do not include support you received directly from your institution or support from a faculty member's grant funding.*

Nationally-competitive fellowships *are unrestricted fellowships granted by a federal agency, private foundation, or similar organization directly to an individual graduate student (or graduate school applicant) for use at any graduate institution of his/her choosing. Check one only*

- ❑ Yes
- ❑ No

FELLOW, GO TO ITEM C9.
UNFUNDED, GO TO ITEM Module D (Item D1a)

C9. As of October 1, 2010, had you completed your IRFP fellowship (including any U.S.-based "re-entry period")? *Check one only*

- ❑ Yes → **Go to D1a**
- ❑ No → **R will receive items in Module E and Module G; Do not Present Modules D, F.**

MODULE D: PROFESSIONAL HISTORY

In this section, we ask about various professional experiences you've had up to October 1, 2010. We use a standard date so that all survey participants think about the same period of time when answering these questions.

D1a. Since receiving your first doctoral degree how many postdoctoral appointments have you held? Please include any postdocs you held through October 1, 2010. **Please include IRFP if you received an award**.

Enter Number of postdocs [textbox 2] or if None, enter 0.
If 0, skip to D1c, else go to D1b.

D1b. **[all applicants]**: Since receiving your first doctoral degree, how many postdoctoral appointments have you held at institution(s) **outside the United States**? Please include any postdocs you held through October 1, 2010. **Please include IRFP if you received this fellowship**. *Check one only*

- ❑ 0
- ❑ 1
- ❑ 2
- ❑ 3 or more

D1c. During the week of October 1, 2010 were you working for pay or profit? Work includes being self-employed, on a postdoctoral appointment, or on any type of paid or unpaid leave, including vacation. Check one only

- ❑ Yes, in a postdoctoral position → **GO TO D4**
- ❑ Yes, in another type of position (i.e., not a postdoctoral position) → **GO TO D2**
- ❑ No, I was not working then → **GO TO D5**

D2. Was your primary employer during the week of October 1, 2010 an educational institution? *Check one only*

- ❑ Yes → **GO TO D2a**
- ❑ No → **GO TO D3**

D2a. Was the educational institution where you worked a . . . *Check one only*

- ❑ Preschool, elementary, middle, or secondary school or system → **GO TO D4**
- ❑ Two-year college, community college or technical institute
- ❑ Four-year college or university,* other than a medical school
- ❑ Medical school (including university-affiliated hospital or medical center)
- ❑ University-affiliated research institute
- ❑ Other educational institution [please specify]: [textbox, 150]

Four-year college/university includes doctoral-granting and non-doctoral-granting institutions.

D2b. During the week of October 1, 2010 what type of academic position did you hold at this institution? *Mark Yes or No for each item.*

Yes	No	
❑	❑	President, Provost, or Chancellor (any level)
❑	❑	Dean (any level), department head or chair
❑	❑	Research faculty, scientist, associate or fellow
❑	❑	Teaching faculty
❑	❑	Adjunct faculty
❑		Other (please specify: [textbox, 75])

D2c. During the week of October 1, 2010 what was your faculty rank? *Check one only*

- ❑ Not applicable: no ranks designated at this institution
- ❑ Not applicable: no ranks designated for my position
- ❑ Professor/Full Professor
- ❑ Associate Professor
- ❑ Assistant Professor
- ❑ Instructor
- ❑ Lecturer
- ❑ Other: [textbox, 75]

D2d. What was your tenure status? *Check one only*

- ❑ Not applicable: no tenure system at this institution
- ❑ Not applicable: no tenure system for my position
- ❑ Tenured
- ❑ On tenure track but not tenured
- ❑ Not on tenure track

→ after D2d, SKIP to D4

D3 only for respondents where D2 = NO (primary employer during the week of October 1, 2010 was not an educational institution)

D3. Which of the following best describes your primary employer during the week of October 1, 2010? *Check one only*

- ❑ SELF-EMPLOYED or a BUSINESS OWNER (non-incorporated or incorporated business, professional practice, or farm)
- ❑ PRIVATE SECTOR (for-profit or non-profit, including tax-exempt and charitable organizations)
- ❑ Local GOVERNMENT (city, county, school district)
- ❑ State GOVERNMENT
- ❑ U.S. federal GOVERNMENT
- ❑ U.S. MILITARY service, activity duty or Commissioned Corps (e.g., USPHS, NOAA)
- ❑ OTHER type of employer: Please specify: [textbox, 300]

D4. In performing the primary job you held during the week of October 1, 2010, did you work with individuals located in countries other than the US? *If you were a postdoctoral fellow during this period, please consider the postdoctoral fellowship to be your primary job. Check one only*

- ❑ Yes → **GO TO D4a**
- ❑ No → **GO TO D5**

D4a. Did your work with individuals in countries other than the US involve. . .

Mark Yes or No for each item.

Yes	No	
❑	❑	Sharing data or information?
❑	❑	Sharing materials, equipment, or facilities?
❑	❑	Preparing a joint publication?
❑	❑	Jointly developing a product, process, or program?
❑	❑	Collaborating on a research project?
❑		Other type of work? Specify: [textbox, 300]

D4b. For the primary job you held during the week of October 1, 2010 were you employed at a location outside the U.S.? *If you were based in the United States but travelled internationally for this job, you should answer "No."*

- ❑ Yes
- ❑ No

D5. Between [year of IRFP application] and October 1, 2010, did you receive any grants (as Principal Investigator or co-Principal Investigator), prestigious awards or honors based on your research? *If you were an IRFP fellow, do not count the IRFP Fellowship itself. Mark one answer in each row.*

Not applicable for my position (e.g., not eligible for grants/awards)	Yes	No	
❑	❑	❑	Grant(s) as Principal Investigator
❑	❑	❑	Grant(s) as co-Principal Investigator
❑	❑	❑	Prestigious award(s)/honor(s)

If any row in D5 = Yes: → Former IRFP Fellows, GO TO D5a; Unfunded applicants, SKIP to D5b
If ALL rows in D5 = No or Not applicable → GO TO D6.

D5a. [**former IRFP Fellows only**] Were any of these grants or awards based on research conducted or advanced during your IRFP fellowship? *Check one only*

- ❑ Yes
- ❑ No
- ❑ Not sure

D5b. What was the name of the most prestigious grant, award or honor for research you have received and who did it come from?

(i) Name of award: [textbox, 300]

(ii) The award was from: *Check one:*

- ❑ An international organization or foreign government
- ❑ A U.S. government agency
- ❑ A US-based professional association
- ❑ A private foundation in the U.S.
- ❑ An institution where I was employed or my doctoral institution
- ❑ None of the above

(iii) Please type the full name of the awarding agency or organization: [textbox, 300]

D6. Between [year of IRFP application] and October 1, 2010, how many of the following works had you published or produced (on your own or with others)?

Include works "in press" but do not include works "under review" or "in preparation." Include works published in electronic or printed format but do not count the same work more than once if it is available in multiple formats.

Make your best approximation if you do not know the exact number.

The first row should not appear on-screen and the column "IRFP Fellows only" should appear only for FELLOWS not for UNFUNDED APPLICANTS

Do not display this row onscreen	All Respondents	All respondents	IRFP Fellows only:
	Total (if none, enter "0")	How many of these from collaboration with foreign colleague(s)?	How many of these from collaboration with your IRFP host?
Peer-reviewed journal articles			
Peer-reviewed conference publications (e.g. abstracts, conference papers, posters)			
Patents, registered or pending			
Book chapter(s) (e.g., in edited volumes)			

IF (year_of _application = 2008) OR (year_of_application = 2009) THEN
IF (AWDSTATUS =1 AND C9 = YES) THEN DO
after item D6, SKIP TO ITEM D9; and
after item D9, SKIP TO ITEM E1
Else IF AWDSTATUS=2 THEN after item D6, SKIP TO ITEM G1
ELSE skip patterns unchanged.

For IRFP applicants who applied for the 2008 or 2009 year, survey items D7, D8, and D10 would not make sense. These items include the variable "[Year of application +2]" which would have equaled 2010 or 2011. The resulting items would not have made sense. For example, consider Item D7:

D7. Between [year of IRFP application + 2] and October 1, 2010, have you ever worked in another country? ("Work" refers here to employment for pay or profit and includes postdoctoral appointments.)

For IRFP Applicants for the 2008 cohort:

D7. Between 2010 and October 1, 2010, have you ever worked in . . .

For IRFP Applicants for the 2008 cohort:

D7. Between 2011 and October 1, 2010, have you ever worked in . . .

As a result, after Item D6, the following code was used to SKIP such respondents out of these items:

IF (year_of _application = 2008) OR (year_of_application = 2009) THEN
IF (AWDSTATUS =1 AND C9 = YES) THEN DO
after item D6, SKIP TO ITEM D9; and
after item D9, SKIP TO ITEM E1
Else IF AWDSTATUS=2 THEN after item D6, SKIP TO ITEM G1
ELSE skip patterns unchanged.

D7. Between [year of IRFP application + 2] and October 1, 2010, have you ever worked in another country? ("Work" refers here to employment for pay or profit and includes postdoctoral appointments.) *Check one only.*

- ❑ Yes → **GO TO D7a**
- ❑ No → **GO TO D8**

D7a. For how many years (if less than 1 year, how many months) did you work in another country (or countries)?
I worked in another country/countries for: *Check one only.*

- ❑ Less than 1 year → **Go to D7a_(i)**
- ❑ 1 year or longer → **Go to D7a_(ii)**

D7a_(i). Enter number of months total: [textbox, 2] → **Go to D8**
D7a_(ii). Enter number of years total: [textbox, 2] → **Go to D8**

D7a(i) and D7a(ii) appear on-screen together with D7a.

D8. Between [year of IRFP application + 2] and October 1, 2010, did you mentor any individuals from the United States who conducted research in another country?
Check all that apply

- ❑ I mentored undergraduate students who conducted research abroad
- ❑ I mentored graduate students who conducted research abroad
- ❑ I mentored postdocs who conducted research abroad
- ❑ I mentored faculty who conducted research abroad
- ❑ I mentored research scientists who conducted research abroad
- ❑ I mentored other individuals who who conducted research abroad
- ❑ I did not mentor any individuals who conducted research abroad

Former IRFP Fellows: Go to D9
Unfunded applicants: Go to D10

(Fellows only):
In this next question, we're interested in any effects that your participation in IRFP may have had on people or institutions you've worked with in the U.S. since the end of your IRFP fellowship.

D9. Since the end of your IRFP fellowship, have you done any of the following?

	Yes	No	Not applicable
I have taught my colleagues, students, or peers research methods that I learned during my IRFP fellowship	❑	❑	❑
I have shared with my colleagues resources (e.g., data, samples, materials) or tools (e.g., algorithms, software, instruments) that I collected developed during my IRFP fellowship	❑	❑	❑

Continue to D10

(IRFP Fellows and Unfunded applicants):

D10. Between [year of IRFP application +2] and October 1, 2010, have you done any of the following:

	Yes	No	Not applicable
I have established a program to foster international collaborations	❑	❑	❑
I have hosted researchers or professional colleagues from another country at my institution	❑	❑	❑
I have led a delegation of colleagues to visit a research laboratory, university, or business in another country	❑	❑	❑
I have established or served in a leadership role for an international association for professionals in my line of work	❑	❑	❑

Unfunded applicants: Go to Module G (DEMOGRAPHICS)
Fellows: Go to Module E (THE IRFP FELLOWSHIP EXPERIENCE)

MODULE E: THE IRFP FELLOWSHIP EXPERIENCE
In this section, we'd like to ask about experiences you had during your IRFP Fellowship.

E1. In preparation for your IRFP fellowship, did you study a language spoken in your host country? *Check all that apply.*

- ❑ No, I was already familiar with the language spoken in the host country
- ❑ No, I did not study a language spoken in the host country
- ❑ Yes, I did some self-guided language study (i.e., individual study using books or computer-based instructional software, such as *Rosetta Stone*)
- ❑ Yes, I studied with a conversation partner or a tutor who was familiar with a language spoken in the host country
- ❑ Yes, I enrolled in a formal language training course led by an instructor (either an online course or "live" course)

E2. During your IRFP fellowship, did you attend or participate in any of the following types of cultural or leisure activities in your host country? *Check all that apply*

- ❑ Sightseeing
- ❑ Museums
- ❑ Festivals, holiday or religious ceremonies
- ❑ Outdoor activities to explore the landscape, geography
- ❑ Sporting events
- ❑ Non-scientific lectures or presentations
- ❑ Other (please specify):
- ❑ I did not participate in any cultural activities

E3. During your IRFP fellowship, did you attend or participate in any of the following types of professional activities? *Check all that apply*

- ❑ Visit(s) to educational or research institutions other than my host institution
- ❑ Visit(s) to businesses/industrial laboratories
- ❑ Language courses or language study
- ❑ Lectures, colloquia, seminars in my field
- ❑ Attended professional conferences in my host country
- ❑ I gave a talk or presentation to researchers from my host country
- ❑ Networking with colleagues from institutions other than my host institution
- ❑ Other (please specify):
- ❑ I did not attend or participate in any professional activities

E3a. Please describe one of the most memorable activities or events you experienced in your host country:

textbox, 2500

E4. Who was primarily involved in the following activities related to the IRFP project(s) on which you worked? *Mark one answer in each row.*

	Mostly me independently	Mostly the host or members of his/her group without me	Me and the host or host's research group together about equally	Not applicable
Developing the ideas, hypotheses, broad framework, or vision for the research project	❑	❑	❑	❑
Researching literature or research base relevant to the project	❑	❑	❑	❑
Keeping records, tracking supplies, resources	❑	❑	❑	❑
Developing instrumentation, software, equipment, or data collection processes	❑	❑	❑	❑
Collecting data or carrying out simulations	❑	❑	❑	❑
Analyzing data or observations	❑	❑	❑	❑
Interpreting results	❑	❑	❑	❑
Planning or developing follow-up work based on results	❑	❑	❑	❑
Written, oral dissemination of results (publications, presentations)	❑	❑	❑	❑

E5. Did you experience any of the following difficulties during your fellowship? *Check all that apply.*

- ❑ Inadequate access to space, facilities, equipment, computers, resources/supplies
- ❑ My role on the project was less than that merited by my skills/knowledge
- ❑ Not enough guidance from host/host's research group
- ❑ I was asked to do work that was someone else's responsibility
- ❑ Not given credit for my contributions to advancing a project
- ❑ Communication or language difficulties
- ❑ Logistical difficulties (e.g., with transportation, navigating bureaucracy, etc.)
- ❑ Legal or medical difficulties in my host country
- ❑ I felt that my ideas were not treated with respect
- ❑ Encountered barriers or discomfort based on my gender
- ❑ Encountered barriers or discomfort based on my race/ethnicity
- ❑ Encountered barriers or discomfort based on my cultural or religious background
- ❑ Encountered barriers or discomfort based on a disability
- ❑ Other (please specify): [textbox, 300]
- ❑ None

E6. During your IRFP fellowship, who provided direct supervision while you were conducting your work? *Check all that apply.*

- ❑ The host researcher him/herself
- ❑ Another staff scientist
- ❑ A junior faculty member or post-doctoral fellow
- ❑ Another graduate student(s)
- ❑ A laboratory technician or other employee/worker
- ❑ No one, I was not supervised by anyone

E7. Please indicate how satisfied you were with various aspects of your IRFP experience. *Mark one answer in each row.*

Accommodations & Logistics	Very dissatisfied	Somewhat dissatisfied	Somewhat satisfied	Very satisfied
Lodging	❑	❑	❑	❑
Fellowship support amount	❑	❑	❑	❑
Fellowship duration	❑	❑	❑	❑
Fellowship timing with respect to your career goals	❑	❑	❑	❑
Research/laboratory facilities at the host location	❑	❑	❑	❑
Access to the internet	❑	❑	❑	❑
Your host	**Very dissatisfied**	**Somewhat dissatisfied**	**Somewhat satisfied**	**Very satisfied**
Frequency of meetings with your host	❑	❑	❑	❑
Match between yours and your host's research interests	❑	❑	❑	❑
Host's expertise in his/her field	❑	❑	❑	❑
The level of the host's intellectual contribution to your joint research project	❑	❑	❑	❑
Host's efforts to help you meet other researchers	❑	❑	❑	❑
Host's inclusion of you in research group/laboratory, meaningful collaboration	❑	❑	❑	❑
Guidance or mentoring provided by host	❑	❑	❑	❑
Your experiences	**Very dissatisfied**	**Somewhat dissatisfied**	**Somewhat satisfied**	**Very satisfied**
Opportunities to experience and learn about your host country, its culture, history, etc	❑	❑	❑	❑
The quality of research you were able to conduct	❑	❑	❑	❑
Professional connections you made during the fellowship	❑	❑	❑	❑

E7a. If you would like to elaborate or comment further on areas of satisfaction or dissatisfaction with your IRFP experience, please do so:

textbox, 2500

MODULE F: AFTER YOUR IRFP FELLOWSHIP

F1. Since the conclusion of your IRFP fellowship and October 1, 2010, have you collaborated or communicated with your host scientist? *Check one only*

- ❑ I have collaborated on a research project → **GO TO F1a**
- ❑ I have communicated with my host but haven't collaborated further on research → **GO TO F1c**
- ❑ I have not communicated with my host → **GO TO F1c**

F1a. What was the extent of your collaboration? *Check all that apply*

- ❑ I have a position in the host's group
- ❑ I have a position at the host's institution
- ❑ We exchanged ideas, data, ideas, research results, or tools
- ❑ We co-authored papers
- ❑ We co-advised students
- ❑ We visited each other at our institutions
- ❑ Other – specify [textbox, 300]

F1b. How recently has the latest collaboration with your host occurred? *Check one only*

- ❑ Within the past 6 months → **GO TO F2**
- ❑ Within the past 12 months → **GO TO F2**
- ❑ 1-2 years ago → **GO TO F2**
- ❑ 3 or more years ago → **GO TO F2**

F1c. Why do you no longer collaborate with your former host? *Check all that apply*

- ❑ Our research interests diverged
- ❑ One or both of us lacked funding needed to maintain collaboration
- ❑ Language differences have hindered further collaboration
- ❑ Political or cultural differences have hindered further collaboration
- ❑ Geographic distance has hindered further collaboration
- ❑ I did not think that further collaboration would be beneficial for me
- ❑ My host did not actively pursue or maintain further collaboration with me
- ❑ One (or both) of us is too busy with other projects
- ❑ Other – specify [textbox, 300]

F2. Did participating in IRFP make you qualified for a broader range of opportunities after the fellowship ended? *Check one only*

- ❑ Yes, IRFP broadened my career options → **Go to F2a**
- ❑ No, IRFP did not broaden my career options → **Go to F2b**
- ❑ I am not sure → **Go to F3**

F2a. Describe how IRFP broadened your career options:

textbox, 2500

SKIP TO F3

F2b. Did IRFP constrain your career options? *Check one only*

- ❑ Yes → Go to F2c
- ❑ No → Go to F3

F2c. Describe how IRFP constrained your career options:

textbox, 2500

F3. Which of the following professional benefits occurred as a result of your participation in IRFP? *Check all that apply*

- ❑ My work at the host institution resulted in a substantial advancement in my research
- ❑ My work at the host institution opened up new areas of investigation
- ❑ I became familiar with scientific enterprise of the host country
- ❑ I became committed to international research collaboration
- ❑ I made valuable connections to researchers in the host country
- ❑ My career goals changed from an academic career to a non-academic career
- ❑ My career goals changed from a non-academic to an academic career
- ❑ I decided to pursue research in a different discipline than the one I was most familiar with when I began my IRFP fellowship
- ❑ IRFP participation made me more competitive for jobs I was interested in
- ❑ IRFP participation made me consider professional opportunities I would not have considered in the past
- ❑ None of the above

F3a. What did your IRFP host scientist do to assist you in obtaining employment after your fellowship? *Check all that apply.*

- ❑ Helped me network with potential employers
- ❑ Recommended me to others directly, by telephone or in-person
- ❑ Reviewed my CV/resume and/or other application materials
- ❑ Wrote letters of reference on my behalf
- ❑ Provided financial assistance for travel to conference, other professional networking opportunities
- ❑ Other (please specify): [textbox 300]
- ❑ Host offered me no assistance finding post-fellowship employment

F4. Which of the following additional benefits occurred as a result of your participation in IRFP? *Check all that apply*

- ❑ Research methods or ideas that I learned benefited others in my institution
- ❑ Samples that I collected or tools that I developed benefited others in my institution
- ❑ My peers became interested in international collaboration
- ❑ Others in my research group (in the U.S.) began an international research collaboration
- ❑ Researchers that I met during my fellowship joined my research group in the U.S.
- ❑ Other – specify [textbox, 300]
- ❑ None of the above

F5. Which of the following personal benefits occur as a result of your participation?
Check all that apply.

- ❑ I became comfortable with the traditions and culture of the host country
- ❑ I made personal connections in the host country
- ❑ I gained proficiency in another language
- ❑ I decided to live outside the United States (i.e., at least 6 months)
- ❑ None of the above

F6. Which of the following are true? *Check Yes or No for each*

Yes	No	
❑	❑	Obtaining full-time employment after the conclusion of my IRFP fellowship was more difficult than I expected
❑	❑	I lost an important career or educational opportunity by participating in IRFP
❑	❑	I am more skeptical about international collaboration than before IRFP

F7. What was the most positive aspect of your IRFP experience?

Textbox 2500

F8. What was the most challenging aspect of your IRFP experience?

Textbox 2500

F9. Would you recommend IRFP to a colleague? *Check one only*

- ❑ Yes
- ❑ No

F9a. Why or why not?

textbox, 2500

F10. Would you recommend your IRFP host scientist to a colleague seeking an international collaboration? *Check one only*

- ❑ Yes
- ❑ No

F11. Would you recommend your host country to a colleague? *Check one only*

- ❑ Yes
- ❑ No

F12. What would you change about the IRFP program?

Textbox 2500

F13. What was the most important contribution of IRFP participation to your career?

Textbox 2500

MODULE G: DEMOGRAPHIC INFORMATION

G1. What is your gender?

- ❑ Male
- ❑ Female

G2. What is your ethnicity? *Mark one only.*

- ❑ Hispanic or Latino
- ❑ Not Hispanic or Latino

G3. What is your race? *Check one or more.*

- ❑ American Indian or Alaska native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or other Pacific Islander
- ❑ White

G4. What is your citizenship status?

- ❑ United States citizen since birth → **Go to G5**
- ❑ United States citizen, naturalized → **Go to G4a**
- ❑ Non-U.S. citizen with a permanent U.S. Resident Visa ("Green Card") → **Go to G4a**
- ❑ Non-U.S. citizen with a temporary U.S. Visa → **Go to G4a**

G4a. How old were you when you began living in the United States? (age in years): [textbox, 2]

The next question is designed to help us better understand the career paths of individuals with different physical disabilities:

G5. What is the USUAL degree of difficulty you have with: *Mark one answer for each item.*

		None	Slight	Moderate	Severe	Unable to do
1	SEEING words or letters in ordinary newsprint (with glasses/contact lenses, if you usually wear them)	❑1	❑2	❑3	❑4	❑5
2	HEARING what is normally said in conversation with another person (with hearing aid, if you usually wear one)	❑1	❑2	❑3	❑4	❑5
3	WALKING without human or mechanical assistance or using stairs	❑1	❑2	❑3	❑4	❑5
4	LIFTING or carrying something as heavy as 10 pounds, such as a bag of groceries	❑1	❑2	❑3	❑4	❑5

If all 4 rows in G5 are marked "None," Go to Thank you screen. Else go to G5a.

G5a. What is the earliest age at which you first began experiencing any difficulties in any of these areas?

❑ Since birth; or Enter age in years: __|____

valid data range is 0 to 99yrs

SUBMIT SURVEY

Thank you screen: After hitting SUBMIT, respondent sees this screen.

IRFP applicant survey

Conclusion
Thank you for completing this survey. If you have any general comments about the survey, please write them below.

Textbox, 2500

If you have any questions about this survey or the study, please contact Dr. Alina Martinez, Study Director, Abt Associates, at (866) 421-6223 (toll-free within the US) or email her at IRFP_survey@abtassoc.com. You may also contact John Tsapogas, who is overseeing this study at NSF, with any questions or comments: jtsapoga@nsf.gov.

Thank you for your assistance. We greatly appreciate your time and consideration.

CONFIRM FELLOWSHIP SCREEN

Programming note: From these screens respondent should be able to go back to the previous item that triggered this screen. For example, if they accidentally selected a response on A2.1 or A2.2 that they did not intend, they need the option to return and fix it.

Before continuing, we'd like to note that NSF records may have an error. For example, the records may have confused the International Research Fellowship Program (IRFP) and the NSF-NATO Postdoctoral Science and Engineering Fellowship program. The NSF-NATO postdoc differs from the IRFP award:

- **NSF-NATO postdoctoral fellowships** provided up to 12 months of funding for research in one of the NATO member countries or NATO partner nations:
  Albania, Armenia, Azerbaijan Belgium, Belarus, Bulgaria, Canada, Czech Republic, Denmark, Estonia, France, Georgia, Germany, Greece, Hungary, Iceland, Italy, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Luxembourg, Moldova, the Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, Spain, Tajikistan, Turkey, Turkmenistan, Ukraine, the United Kingdom, Uzbekistan or the former Yugoslav Republic of Macedonia;
- **IRFP fellowships** provided 3 to 24 months of funding for research in any country.

Some survey participants applied separately for both IRFP and NSF-NATO (and/or other postdoctoral programs). In a few instances, NSF records may have classified an applicant to the International Research Fellowship Program incorrectly. We ask for your forbearance.

Currently, NSF's records indicate that you (if FELLOW display Section S only; if UNFUNDED APPLICANT display Section R only)

Section R (unfunded applicants)

applied for, but did not participate in, a postdoctoral fellowship through NSF's "International Research Fellowship Program (IRFP)." You may have participated in a different NSF postdoctoral program, OR these records may be mistaken. Please select the response below that is most accurate:

- ❑ I applied for a postdoctoral fellowship from NSF's IRFP program, but participated in a postdoctoral fellowship from a different NSF program (for example, the NSF-NATO program) → **Go To R1**
- ❑ I applied for, but did not participate in, a postdoctoral fellowship from NSF's IRFP program →**Go to R1**
- ❑ I applied for, and did participate in, a postdoctoral fellowship from NSF's IRFP program. → **GOTO R2**
- ❑ I never applied to NSF for any internationally-based postdoctoral fellowship. → **Go To EXIT SCREEN**

R1: Because you applied to NSF's "International Research Fellowship Program (IRFP)," we especially need you to complete this survey. The survey focuses on your professional achievements, the type of work you do currently and the types of collaborations you may have with scientists and engineers in the US and other countries. **The value of this study to NSF and to the broader scientific community depends on the participation of individuals who applied for an IRFP postdoctoral fellowship. Please click here to return to the survey: RETURN Go to Item A2.3a**

A2.3a Did you apply for a [**IRFP_Year**] IRFP postdoctoral fellowship?

- ❑ Yes
- ❑ No, I applied for a different year (Enter four-digit year): [yyyy] Set IRFP_Year = entry and FLAG IRFP_YEAR_CHANGE = 1

AFTER A2.3a, GO TO A3

R2 (award status change): We apologize for the error, and we thank you for correcting our records. We especially need you to complete this survey. This survey focuses on your international experiences, professional achievements, the type of work you do currently and the types of collaborations you may have with scientists and engineers in the US and other countries. **If you would please continue, we have updated your status to "former IRFP postdoctoral fellow." Please click here to return to the survey. RETURN**

SET AWDSTATUS = 1 AND GOTO Item A2.3b. FLAG RESPONDENT AS 'AWDSTATUS_CHANGE=1' for our analysis purposes.

A2.3b Did your IRFP postdoctoral fellowship begin in [IRFP_Year]?

- ❑ Yes
- ❑ No, it began in (Enter four-digit year): [yyyy] Set IRFP_Year = entry and FLAG IRFP_YEAR_CHANGE = 1

AFTER A2.3b, GO TO A3

Section S (awardees)

participated in a postdoctoral fellowship through NSF's "International Research Fellowship Program (IRFP)." You may have participated in a different NSF postdoctoral program, OR these records may be mistaken. Please select the response below that is most accurate:

- ❑ Yes, I participated in a postdoctoral fellowship from NSF's IRFP program → **Go to S1**
- ❑ I participated in an NSF-supported postdoctoral fellowship outside the U.S., but I'm not sure what NSF program supported this postdoc. → **Go to S1**
- ❑ I applied for, but did not participate in, a postdoctoral fellowship from NSF's IRFP program → **Go to S2**
- ❑ I never applied for a postdoctoral fellowship from NSF's IRFP program. → **Go to EXIT SCREEN**

S1: We especially need you to complete this survey. This survey focuses on your international experiences, your professional achievements, the type of work you do currently and the types of collaborations you may have with scientists and engineers in the US and other countries. **Please click here to return to the survey: RETURN Go to Item A2.3b**

A2.3b Did your IRFP postdoctoral fellowship begin in [**IRFP_Year**]?

- ❑ Yes
- ❑ No, it began in (Enter four-digit year): [yyyy] Set IRFP_Year = entry and FLAG IRFP_YEAR_CHANGE = 1

AFTER A2.3b, GO TO A3

S2 (AWARD STATUS CHANGE) Thank you for correcting our records – we apologize for the error and we have updated your status. We especially need you to complete this survey. The value of this study depends on the participation of individuals who applied for an IRFP postdoctoral fellowship. Please click here to return to the survey. RETURN

SET AWDSTATUS = 2 AND GOTO Item A2.3a. FLAG RESPONDENT AS 'AWDSTATUS_CHANGE=1' for our analysis purposes.

A2.3a Did you apply for a [**IRFP_Year**] IRFP postdoctoral fellowship?

- ❑ Yes
- ❑ No, I applied for a different year (Enter four-digit year): [yyyy] Set IRFP_Year = entered text and FLAG IRFP_YEAR_CHANGE = 1

AFTER A2.3a, GO TO A3

EXIT SCREEN:
If we have identified the wrong respondent or have erroneous information, display this screen and FLAG this respondent for Abt follow-up (weekly basis)

IRFP applicant survey

Please accept our apology.
The information you supplied suggests that you are not eligible to participate in this study **or** that we have reached you in error. We regret any inconvenience to you. If you have any questions about this study or you would like to make a comment, please contact one of the following individuals:

- Dr. Alina Martinez, Study Director at Abt Associates: IRFP_survey@abtassoc.com, or (866) 421-6223 (toll free within the U.S.);
- John Tsapogas, Office of International Science and Engineering, NSF: jtsapoga@nsf.gov.

May we have permission to contact you by telephone in order to clarify your responses here? Entering your number does not obligate you to answer any questions.

- ❑ Yes, you may reach me at _ _ _ _ _ _ _ _ _ _ _ _ . [telephone digit entry]. **Go to Best Times**
- ❑ No, please do not contact me.

Best time(s) to call (*check all that apply*):

- ❑ Weekdays (9 to 5pm)
- ❑ Evenings (5 to 8pm)
- ❑ Saturday or Sunday 9-5pm

THIS PAGE SHOULD NOT REQUIRE ANY ENTRY
THIS PAGE SHOULD HAVE A PREVIOUS ITEM BUTTON

Defaults: If A1, A2.1/A2.2, and/or A4a. are blank, no reminder needed but use the default below for skip patterns:

A1. Based on the information that you provided to NSF in your application, your name is [First Name, Middle Name/initial, Last Name]. Is this correct?

❑ Yes, this is correct.

[IRFP awardees only]

A2.1. Based on the information contained in the NSF database, you participated in the National Science Foundation's International Research Fellowship Program starting in [**Year of application**]. Is this correct? *If you participated in IRFP more than once, please consider your most recent experience*

❑ Yes, this is correct. → **GO TO A3**

[Unfunded applicants only]

A2.2. Based on the information contained in the NSF database, you applied for the National Science Foundation's International Research Fellows Program (IRFP) in [year of application], but did not participate in a fellowship. Is that correct?

❑ Yes, this is correct.→ **GO TO A3**

A4a. Our records indicate that you received your doctorate in [**phdyear**]. Is this correct?

❑ Yes, this is correct. → **GO TO A5**

Reminders to display on first time item is left blank:

A3. Based on the information in the NSF database, you applied to spend your IRFP fellowship in [**IRFP country**]. Is this correct?

Please select a response before continuing to the next item. [it is ok if this item is still left blank]

A5. What discipline best characterizes your field of research when you applied for an IRFP fellowship (that is, your doctoral field of research)? First, indicate which one of four broader areas in which your discipline falls:

Check one only:

Please select a response before continuing to the next item. [it is ok if this item is still left blank]

❑$_1$ Sciences (Biological/Life, Chemical, Computer/Information, Environmental, Earth/Atmospheric/Oceanographic, Geosciences, Mathematical/Statistical, Physics, Psychology)

❑$_2$ Social Sciences (Economics, Sociology, Anthropology/Archaeology, Political Science, Geography, Linguistics, other)

❑$_3$ Health/Medical

❑$_4$ Engineering

[and it's also ok if no 3-digit code/subcategory is selected within "Sciences" or "Social Sciences" or "Health/Medical" or "Engineering" -- no reminder needed]

C1. At the time you applied for an IRFP Fellowship ([year_of_application]) were you employed in a tenure-track faculty position? *Check one only*
No response selected. Please select a response to the best of your recollection. [it is ok if this item is still left blank]

C2a. At the time you applied for IRFP ([year_of_application]), what was the highest degree you had completed? *You may have applied before you officially received your doctorate, for example. Check one only:*
Please select a response before continuing to the next item. [it is ok if this item is still left blank]

C9. As of October 1, 2010, had you completed your IRFP fellowship (including any U.S.-based "re-entry period")? *Check one only*
Please select a response before continuing to the next item. [it is ok if this item is still left blank]

D1c. During the week of October 1, 2010 were you working for pay or profit? Work includes being self-employed, on a postdoctoral appointment, or on any type of paid or unpaid leave, including vacation. *Check one only*
Please select a response before continuing to the next item. [it is ok if this item is still left blank

D2. Was your primary employer during the week of [October 1, 2010] an educational institution? *Check one only*
No response selected. If you did not mean to leave this item blank, please check one:
[if left blank, default is "yes" and go to D2a]

D4. In performing the primary job you held during the week of [October 1, 2010], did you work with individuals located in countries other than the US? *Check one only. If you held a postdoctoral appointment at this time, please consider that your primary job.*
No response selected. If you did not mean to leave this item blank, please check one:
[if left blank, default is "no" and go to D5]

D7. Between [year of IRFP application + 2] and October 1, 2010, have you ever worked in another country? ("Work" refers here to employment for pay or profit and includes postdoctoral appointments.) *Check one only.*
No response selected. If you did not mean to leave this item blank, please check one: [if left blank, default is "no" and go to D8]

- ❑ Yes → **GO TO D7a**
- ❑ No → **GO TO D8**

International Research Fellowship Program (IRFP)
IRFP Host Survey Items

IRFP HOST SURVEY
Programming notes (not to be displayed) will appear in **red** or **brown** text throughout.
Hyperlinked text will appear embossed and underlined in this document but should not be formatted this way onscreen unless noted (underlining is fine except for email addresses, but embossing is not).

General guidelines:
Each screen should display one question at a time unless otherwise indicated.
Each screen should display a standard set of Navigation buttons shown below.

Some items contained placeholders for fields that were programmed to be auto-filled from the sample file for each respondent. These fields are enclosed in [brackets] and printed in **brown.** Textboxes for open-ended responses are indicated with [**textbox, 150**] where the number indicates the length of the field (how many characters the respondent may type)

Sample variables used in Host Survey:

Fellow name: The first and last name of the IRFP fellow from the sample file

Host First Name, Host Last name: first and last name of the IRFP HOST from the sample file

Year of IRFP: The year that the Fellow began his/her fellowship

Host institution: The name of the institution where the IRFP fellow and host were based.

Survey of Host Scientists for former NSF-IRFP Postdoctoral Fellows

A study for the National Science Foundation of the United States

Welcome and thank for your interest in this study. This survey is being conducted by Abt Associates Inc. and our subsidiary, Abt SRBI, for the National Science Foundation (NSF), to learn about the experiences of individuals who participated as a host to a postdoctoral fellow supported by NSF's International Research Fellowship Program (IRFP). This survey will give NSF information about the international collaborations of U.S. postdoctoral fellows and help NSF improve programs intended to foster a globally engaged scientific and engineering workforce. You are receiving this survey because you are listed in the IRFP database as a host of a former IRFP postdoctoral fellow. We estimate that it will take approximately 15 minutes to complete the survey.

Confidentiality and Participation

Participation in the survey is voluntary and nonparticipation will have no impact on you or your institution. You may skip questions on the survey or discontinue participation at any time. There are minimal risks associated with your participation. We take your privacy very seriously. Your responses to this survey will be protected under the U.S. Privacy Act. There is minimal risk of breach of confidentiality, and we have put in place procedures to minimize this risk. Reports will never identify you by name, and information from the study will only be reported in the aggregate at the program level, combined with about 250 other responses. We will not reveal responses that you provide on any question in this survey to any of the fellows that you hosted in your institution. Neither will any data that can identify any specific fellow or host be shared with the sponsor of this survey (NSF). When we receive your survey we will detach and store separately your name and other identifying information that could be used to link you to your survey responses. Survey responses will be stored on a secure drive that is only accessible to members on the study team. Only study team web technicians and data analysts from Abt Associates and Abt SRBI will see individual responses that can be linked to you. Survey data files will be shared with NSF at the end of the study, only after study team members have examined the data to be free of any information that could help identify you; this cleaning includes procedures to prevent someone from inferring your identity by analyzing non-identifying data. Hence, we encourage you to respond candidly about your experiences. Separate from your individual responses to the survey we will provide NSF any updated contact information we have found or requested from you. None of this contact information will be linked in any way to your survey responses. At the conclusion of the study, Abt Associates and Abt SRBI will destroy all records, electronic or otherwise, that link you to your survey responses.

Questions about the Survey

If you have questions about the study, please contact the study director, Alina Martinez of Abt Associates Inc. at (866) 421-6223 (may incur international telephone charges if initiated outside the U.S) or email her at IRFP_survey@abtassoc.com. You may also contact the evaluation's program officer at NSF, John Tsapogas (jtsapoga@nsf.gov). If you have questions about your rights as a research participant, you may contact Teresa Doksum, the Abt Institutional Review Board Administrator at (877) 520-6835 (may incur international telephone charges if initiated outside the U.S) or by email: irb@abtassoc.com. To learn more about this study, please refer to the **Frequently Asked Questions** page.

Consent

Please click on "Begin" if you agree to participate in this study. **BEGIN**

This study's IRB approval number is #0494, valid from 8/6/2010 to 8/5/2011. For questions, please contact Teresa Doksum, IRB Administrator, Abt Associates, at irb@abtassoc.com. The valid OMB control no. for this information collection is 3145-0214. (Expires on 12/31/13)

Navigating through the survey:
As you work through the survey, your responses are automatically saved. You may change a response by clicking on the **PREVIOUS ITEM** button. Use the **NEXT ITEM** button to advance to the next question. At any time, you may close your browser if you wish to return and finish at a later time. When you re-open the survey you will be able to click on a link that will take you to the question where you left off. On each page of the survey, you may click on the "**FAQs**" button if you have a question during the survey or need information about how to contact the survey administrator.

When you have completed the survey, please click on the **SUBMIT** button at the end of the survey. You may submit the survey even if there are some questions that you choose not to answer.

CONTINUE

FAQs are Optional screens, displayed only if R clicks on Frequently Asked Questions button

FREQUENTLY ASKED QUESTIONS

What is the International Research Fellowship Program (IRFP)?

The International Research Fellowship Program (IRFP) is a National Science Foundation (NSF) program that provides support for new doctoral-level scientists and engineers to conduct postdoctoral research in a country outside the U.S. for a period of 9 to 24 months.

Why are you doing this study?

NSF is interested in learning about the experiences of researchers who have hosted one or more IRFP fellows from the United States as part of the IRFP program. In particular, NSF would like to understand how host researchers perceive the program and the postdoctoral fellows they have hosted, and what kinds of benefits and challenges host researchers experienced. The information collected in the study will help NSF make improvements to the program, and understand how best to support and encourage international collaboration.

Why have I been selected to participate in this survey?

You have been selected to participate because we have identified you as having hosted one or more U.S. postdoctoral fellows participating in the IRFP program.

How did you get my contact information?

We identified you from records maintained by the National Science Foundation on IRFP participants and the scientists who hosted them. We then confirmed your contact information through an internet search.

How long will this survey take to complete?

We estimate that the survey will take about 15 minutes.

How will you use my comments?

Responses from all survey respondents will be used to answer questions about the experiences of IRFP host researchers with the program and with the guest fellows. We will not reveal responses that you provide on any question in this survey to any of the fellows that you hosted in your

institution. Neither will any data that can identify any specific fellow or host be shared with the sponsor of this survey (NSF).

Has this study been reviewed and approved by a human subjects review board?

Yes, the study was approved by Abt Associates' Institutional Review Board. If you have any concerns about your participation in this survey, please contact Teresa Doksum, Institutional Review Board Administrator at Abt Associates, at (877) 520-6835 or via email at irb@abtassoc.com.

Who is funding the study?

The study has been funded by the National Science Foundation under contract GS-10F-0086K. Abt Associates and Abt SRBI will complete the study.

Who are Abt Associates Inc and Abt SRBI?

Abt Associates is an independent research firm headquartered in Cambridge, Massachusetts. Abt SRBI is a wholly-owned subsidiary of Abt Associates specializing in large-scale data collection and public opinion research. NSF has contracted with Abt Associates and Abt SRBI to design and implement a survey of scientists who hosted a U.S. postdoctoral fellow funded by NSF's International Research Fellowship Program (IRFP).

Survey of Host Scientists for former NSF-IRFP Postdoctoral Fellows

Module A: Verifying Information About You

We would like to ask you about your experiences with hosting a postdoctoral fellow supported by NSF's International Research Fellowship Program. Please respond to the best of your recollection. To begin, we'd like to confirm that we've reached the appropriate person.

Please note: We will not reveal responses that you provide on any question in this survey to any of the fellows that you hosted in your institution. Neither will any data that can identify any specific fellow or host be shared with the sponsor of this survey (NSF).

A1. Based on NSF records, you once hosted a postdoctoral fellow from the U.S. named [Fellow name]. Is this information correct? *Mark one answer*

- ❑ Yes, this is correct.
- ❑ I hosted this person but his/her correct name is: [Textbox, 75]
- ❑ No, I did not host the person named above. → **GO TO EXIT SCREEN**
- ❑ I do not recall. → **GO TO EXIT SCREEN**

A2. Based on NSF records, your name is [First Name, Last Name]. Is this information correct? *Mark one answer*

- ❑ Yes, my name is correct.
- ❑ No, my name has changed or is misspelled above. My name is: [Textbox, 75]
- ❑ No, I am not the person named above. I believe you have reached me by mistake. → **GO TO EXIT SCREEN**

A3. Based on NSF records, you hosted [Fellow name] starting in [Year of IRFP]. Is this information correct? *Mark one answer*

- ❑ Yes, this is correct.
- ❑ No, this is incorrect. This fellow first began a postdoctoral fellowship with me in (Enter 4-digit year): [Textbox, yyyy]

A4. Based on NSF records, you hosted [Fellow name] at [Host institution]. Is this information correct? *Mark one answer*

- ❑ Yes, the institution is correct.
- ❑ No, the institution is incorrect. The correct institution is: [Textbox, 150]

A5. As part of his/her postdoc, [Fellow name] received funding from NSF's International Research Fellowship Program (IRFP). How familiar are you with the IRFP program? *Mark one answer*

- ❑ Until now, I had never heard of this particular program
- ❑ I know that this postdoctoral fellow had received funding from NSF but I was only vaguely aware of the IRFP program
- ❑ I recognize this program by its name but know little else about it
- ❑ I recognize this program and I'm also familiar with its goals

A6. During the week of October 1, 2010, were you working at [Host institution], the institution where you worked when you hosted this IRFP Fellow? *Mark one answer*

- ❑ Yes
- ❑ No, I no longer work there. I am now working at (please tell us the name of your current employer, university, or company): [Textbox, 150]

A7. Which of the following characterizes the department (or research unit within an institute) where you hosted [Fellow Name]? *Check all that apply.*

- ❑ The department (or research unit) where I hosted this person encouraged international collaborations
- ❑ Faculty (or employees) in the department (or research unit) where I hosted this person were rewarded for developing international research partnerships
- ❑ The department (or research unit) where I hosted this person provided financial support to faculty (or employees) pursuing international collaborations
- ❑ The department (or research unit) where I hosted this person promoted (that is, advertised) fellowships and other opportunities for researchers in my country to conduct research in another country
- ❑ The department (or research unit) where I hosted this person hosted foreign researchers visiting my institution for research-related purposes
- ❑ None of the above
- ❑ I do not recall

Module B: Deciding to Host an IRFP Postdoctoral Fellow

The remaining items on this survey refer to the IRFP Fellow named above [Fellow name] and (or) to the period of time during which you hosted this individual at your institution (starting in [Year of IRFP]). If you have hosted more than one IRFP Postdoctoral Fellow, please answer items on this survey with respect to [Fellow name], who you hosted beginning in [Year of IRFP].

B1. How did you first learn about the IRFP program? *Check all that apply*

- ❑ From the IRFP postdoctoral fellow I hosted
- ❑ From the IRFP fellow's PhD (doctoral) advisor
- ❑ From another faculty member at the IRFP fellow's institution in the United States
- ❑ From an administrator at the IRFP fellow's institution
- ❑ From the United States' National Science Foundation (NSF) web site, printed publication, or presentation
- ❑ From a faculty member (or colleague) at my institution
- ❑ From an administrator at my institution
- ❑ From a colleague at an institution other than where I work
- ❑ I do not recall
- ❑ Other. Please specify: [Textbox, 300]

B2. Why did you decide to host this IRFP fellow [Fellow Name]? *Check all that apply*

- ❑ I was interested in the project proposed by the Fellow
- ❑ I was interested in establishing or maintaining collaboration with a US researcher
- ❑ I personally knew, knew of, or previously collaborated with the fellow
- ❑ I personally knew, knew of, or previously collaborated with the fellow's doctoral advisor
- ❑ I personally knew, knew of, or previously collaborated with researchers at the fellow's institution
- ❑ I had a positive experience with the IRFP program in the past
- ❑ I had a positive experience with other U.S. postdoctoral fellows or visiting researchers not funded through IRFP
- ❑ To create an international environment in my research group
- ❑ To attract students/postdocs to my research
- ❑ To learn new methodologies, approaches, or tools from the fellow
- ❑ In my field, individuals trained at U.S. graduate institutions are highly sought-after
- ❑ My research area is particularly suitable for international collaboration
- ❑ Other: [Textbox, 300]

B3. Did you have any of the following concerns about hosting this IRFP postdoctoral fellow? *Check all that apply*

- ❑ The fellow's proposed project was especially risky
- ❑ I was concerned about the fellow's level of commitment to a collaboration with me
- ❑ I was concerned about the risks of international collaboration in general
- ❑ I had a negative experience with the IRFP program in the past
- ❑ I had a negative experience with other U.S. postdoctoral fellows (not funded through IRFP)
- ❑ I was concerned about the integrating this postdoctoral fellow into my research group
- ❑ I was concerned that I might not (or my research group might not) benefit from hosting this fellow
- ❑ In my field, individuals trained at U.S. graduate institutions sometimes have gaps in their knowledge, skills, or abilities
- ❑ My research area is not particularly suitable for international collaboration
- ❑ Other, please specify: [Textbox, 300]

B4. Before hosting [Fellow Name] starting in [Year of IRFP], had you ever before hosted a postdoctoral fellow from the United States? *Mark one answer*

- ❑ Yes, before hosting this person, I had hosted one or more other postdoctoral fellows from the U.S.
- ❑ No, I had never before hosted a postdoctoral fellow from the United States

B5. Prior to hosting this IRFP postdoctoral fellow (i.e., prior to [Year of IRFP]), had you ever visited the United States for educational, research, or other professional purposes? *Check all that apply*

- ❑ I was an undergraduate student in the United States
- ❑ I was a graduate student in the United States
- ❑ I was a postdoctoral fellow in the United States
- ❑ I was a visiting scientist in the United States
- ❑ I was a faculty member in the United States
- ❑ I came to the United States to attend a conference, a workshop, or a meeting
- ❑ Other. Please specify: [Textbox, 300]
- ❑ Before hosting this postdoctoral fellow, I had not visited the United States for any professional purposes

B6. Did you know [Fellow Name] or one (or more) of his/her colleagues before you hosted this IRFP postdoctoral fellow in your country? *Mark one answer*

- ❑ Yes, I knew the fellow before he (or she) came to my country as a postdoctoral fellow
- ❑ I did not know the fellow but I knew one (or more) of his/her colleagues
- ❑ I knew the fellow and one or more of the fellow's colleagues
- ❑ No, I did not know the fellow or any of his/her colleagues

B7. Has [FELLOW NAME]'s IRFP postdoctoral fellowship concluded?

- ❍ Yes, this fellow's IRFP postdoctoral fellowship has ended
- ❍ No, this fellow's IRFP postdoctoral fellowship is still in progress

Module C: Your Experiences as Host to an IRFP Postdoctoral Fellow

IF B7=NO, SHOW TEXT: "For the remaining items in this survey, please respond based on your experiences working with this IRFP postdoctoral fellow *so far*." on separate screen before C1.

C1. Who was primarily involved in the following activities related to the research on which you and the IRFP postdoctoral fellow worked? *Mark one answer in each row.*

	Mostly the fellow independently	Mostly me or members of my group without the fellow	The fellow and I (and/or members of my research group) together about equally	Not applicable (this activity was not part of the research)
Developing the ideas, hypotheses, broad framework, or vision for the research project	❑	❑	❑	❑
Researching literature or research base relevant to the project	❑	❑	❑	❑
Keeping records, tracking supplies, resources,	❑	❑	❑	❑
Developing instrumentation, software, equipment, or data collection processes	❑	❑	❑	❑
Collecting data or carrying out simulations	❑	❑	❑	❑
Analyzing data or observations	❑	❑	❑	❑
Interpreting results	❑	❑	❑	❑
Planning or developing follow-up work based on results	❑	❑	❑	❑
Written, oral dissemination of results (publications, presentations)	❑	❑	❑	❑

C2. Do you agree or disagree with the following aspects of hosting this IRFP postdoctoral fellow? *Mark one answer in each row*

	Strongly disagree	Disagree	Agree	Strongly agree	Does not apply or do not recall
The postdoctoral fellow integrated with staff/members of my research group	❑	❑	❑	❑	❑
The fellow had sufficient knowledge and expertise to be a full participant in a research collaboration with me	❑	❑	❑	❑	❑
The amount of time for the postdoctoral fellowship experience was too short	❑	❑	❑	❑	❑
Language was a barrier to the fellow's ability to interact with me and/or my group	❑	❑	❑	❑	❑
The fellow was willing to take appropriate risks necessary for research	❑	❑	❑	❑	❑
The fellow exercised appropriate caution in his/her approach to research	❑	❑	❑	❑	❑
The fellow spent sufficient time working on the proposed project	❑	❑	❑	❑	❑
Scientific cultures of our countries are similar, making productive collaboration possible	❑	❑	❑	❑	❑
Lifestyles and general cultures of our countries are a barrier to collaboration	❑	❑	❑	❑	❑

IF B7=NO, SKIP TO E1

Module D: Outcomes of hosting an IRFP Postdoctoral Fellow

D1. Since the conclusion of this fellow's postdoctoral fellowship with you, have you collaborated or communicated further with this former postdoctoral fellow? *Mark one answer*

- ❑ I have collaborated further with this individual on research –GO TO D1a
- ❑ I have communicated further with this individual, but we have not collaborated further→ GOTO D2
- ❑ I have not communicated further with this individual → GO TO D2

D1a. How recently has the latest collaboration occurred? *Mark one answer.*

- ❑ Within the past 6 months
- ❑ Within the past 12 months
- ❑ 1-2 years ago
- ❑ 3 or more years ago

D1b. What was/is the nature of this collaboration? *Check all that apply*

- ❑ I have a position in this individual's institution (within the U.S.)
- ❑ This individual has a position at my institution (outside the U.S.)
- ❑ We have exchanged ideas, data, research results, or tools
- ❑ We have co-authored research papers together
- ❑ We have co-advised students together
- ❑ We have visited each other at our institutions
- ❑ Other: [Textbox, 300]

GO TO D3a

D2. Why do you no longer collaborate with this former postdoctoral fellow? *Check all that apply*

- ❑ Our research interests diverged
- ❑ One or both of us lacked funding needed to maintain collaboration
- ❑ Language differences have hindered further collaboration
- ❑ Political or cultural differences have hindered further collaboration
- ❑ Geographic distance has hindered further collaboration
- ❑ I did not think that further collaboration would be beneficial for me
- ❑ The postdoctoral fellow did not actively pursue or maintain further collaboration with me
- ❑ One (or both) of us is too busy with other projects
- ❑ Other – specify [textbox, 300]

D3a. Are you currently collaborating with any of [Fellow Name]'s colleagues? *Check all that apply*

- ❑ With this individual's former faculty advisor
- ❑ With graduate students who work with this former postdoctoral fellow
- ❑ With postdoctoral fellows who work with this former postdoctoral fellow
- ❑ With other researchers who work with this former postdoctoral fellow
- ❑ With none of the above

D3b. Are you currently collaborating with <u>other</u> U.S. researchers? *Mark one answer*

- ❑ Yes→GOTO D3d
- ❑ No→GOTO D4

D3d. Have your collaborations with any U.S. researchers resulted from your participation as host to an IRFP postdoctoral fellow? *Mark one answer*

- ❑ Yes
- ❑ No

D4. Please indicate the number of the following which you published or produced in collaboration with this postdoctoral fellow [Fellow Name]:

Total number published/ in-press with this postdoctoral fellow	
	Peer-reviewed journal articles
	Peer-reviewed conference publications (e.g. abstracts, conference papers, posters)
	Patents, registered or pending
	Book chapter(s) (e.g., in edited volumes)

D4a. In what year did you most recently publish a paper or register a patent with this fellow? (Enter 4-digit year): [Textbox, yyyy]
RANGE: 1990-2010

Module E: Satisfaction with Hosting an IRFP Postdoctoral Fellow

We will not reveal responses that you provide on any question in this survey to any of the fellows that you hosted in your institution. Neither will any data that can identify any specific fellow or host be shared with the sponsor of this survey (NSF).

E1. On a scale of 1-5, with 1 being "*much less satisfied*," and 5 being "*much more satisfied*," how satisfied were you overall with this IRFP postdoctoral Fellow compared to other postdoctoral fellows? *Mark one answer.*

①	②	③	④	⑤
Much less satisfied than I have been with other postdocs	**Somewhat less satisfied** than I have been with other postdocs	**Equally satisfied** as I have been with other postdocs	**Somewhat more satisfied** than I have been with other postdocs	**Much more satisfied** than I have been with other postdocs

If you cannot select a response <u>because you have not worked with any other postdoctoral fellows</u>, please check here: ❑ If Respondent checks this box no rating should be allowed

E1a. What did you find most satisfying or unsatisfying about this fellow or about the IRFP postdoctoral fellowship program as a whole? [Textbox, 2500]

E2. Which of the following benefits (if any) did *you* derive as host to one or more IRFP postdoctoral fellows from the U.S.? *Check all that apply*

- ❑ Hosting an IRFP postdoctoral fellow was the first time I had collaborated with a researcher trained in the U.S.
- ❑ I established or renewed collaboration(s) with <u>other</u> US researchers
- ❑ I published (or researchers in my group published) papers based on work with this fellow
- ❑ I obtained (or researchers in my group obtained) funding based on the collaborative work
- ❑ I gave (or researchers in my group gave) one or more conference presentations based on the collaborative work
- ❑ I learned (or researchers in my group learned) new methodological/analytical techniques or theoretical approaches
- ❑ I became (or researchers in my group became) more familiar with the research enterprise in the United States
- ❑ Improved my ability to communicate in English
- ❑ Hosting an IRFP postdoctoral fellow changed the direction of some research projects in my group
- ❑ Hosting an IRFP postdoctoral fellow enhanced my interest in collaborating with US researchers
- ❑ Hosting an IRFP postdoctoral fellow made other US researchers more interested in collaborating with me or members of my research group
- ❑ None of the above

E3. Did you encounter any of the following challenges when hosting an IRFP postdoctoral fellow? *Check all that apply*

- ❑ The fellow's lack of familiarity with the primary language spoken in my research group made collaboration more difficult than anticipated
- ❑ The fellow and I had differences of opinion about the direction of research
- ❑ The fellow had unanticipated gaps in his/her preparation to conduct research with me
- ❑ The fellow did not devote enough time/effort to the research collaboration
- ❑ The fellow lacked sufficient understanding of cultural norms in my country
- ❑ The fellow was disrespectful, caused conflict within my research group
- ❑ The fellow needed too much guidance
- ❑ The fellow worked too independently, did not work well as a collaborator or team member
- ❑ Other challenges; please specify: [Textbox, 1000]
- ❑ None of the above

E4. Have any of the following taken place *at your institution* as a result of your participation as host to an IRFP Fellow? *Check all that apply*

- ❑ My colleagues increased their own collaborations with US researchers
- ❑ Administration in my department (or research unit) became more supportive of collaboration with US researchers
- ❑ Additional policies, procedures, or structures have been put in place at my institution to facilitate international collaboration
- ❑ Collaborations with US researchers helped attract students and other researchers to my institution
- ❑ Other changes at my institution as a result of hosting IRFP Postdoctoral Fellow (please describe): [textbox, 1500]
- ❑ None of the above

E4a. What were the *best* aspects of your affiliation with this IRFP fellow? [Textbox, 2500]

E5. What were the most challenging aspects in your affiliation with this IRFP fellow? [Textbox, 2500]

E6. Were there any unexpected outcomes in your affiliation with this IRFP fellow? [Textbox, 2500]

E7. Would you recommend (or have you recommended) to others that they host an IRFP postdoctoral fellow from the United States? *Mark one answer*

- ❑ Yes, I would recommend (or I have recommended) to others that they host an IRFP postdoctoral fellow from the United States. GO TO E7a
- ❑ No, I would not recommend to others that they host an IRFP postdoctoral fellow from the United States. GO TO E7b
- ❑ I might recommend hosting an IRFP fellow, but it depends on the qualifications of the individual postdoctoral candidate GO TO E7d
- ❑ I might recommend hosting a postdoctoral fellow from the United States, but the IRFP program created challenges for me or my postdoctoral fellow. GO TO E7c
- ❑ I am not sure. GO TO E7d

E7a. Why would you recommend hosting an IRFP postdoctoral fellow? [Textbox, 2500] Go to E7d

E7b. Why would you not recommend hosting an IRFP postdoctoral fellow? [Textbox, 2500]? Go to E7d

E7c. What challenges did the IRFP program present? [Textbox, 2500]? GO TO E7d

E7d. Based on your experience hosting one or more postdoctoral fellows from the United States, what recommendations would you make to U.S. researchers about working with researchers in your country? [Textbox, 2500]

E8. Please feel free to share any additional thoughts or recommendations about the IRFP program for postdoctoral fellows. [Textbox, 2500]

SUBMIT button takes respondent to Thank you screen.

EXIT SCREEN:
If we have identified the wrong respondent or have erroneous information, display this screen and FLAG this respondent for Abt follow-up (weekly basis)

IRFP host survey

Please accept our apology.
The information you supplied suggests that you are not eligible to participate in this study **or** that we have reached you in error. We regret any inconvenience to you. If you have any questions about this study or you would like to make a comment, please contact one of the following individuals:

- Dr. Alina Martinez, Study Director at Abt Associates: IRFP_survey@abtassoc.com or (866) 421-6223 (may incur telephone charges if initiated outside the U.S.);
- John Tsapogas, Office of International Science and Engineering, NSF: jtsapoga@nsf.gov.

May we have permission to contact you by email in order to clarify your responses here? Answering "yes" does not obligate you to answer any questions.

- ❑ Yes, you may contact me. My preferred email address is: [textbox 150]
- ❑ No, please do not contact me.

Thank you very much.

THANK YOU SCREEN:

IRFP host survey

Conclusion
Thank you for completing this survey. If you have any general comments about the survey, please write them below.

Textbox, 2500

If you have any questions about this survey or the study, please contact Dr. Alina Martinez, Study Director, Abt Associates, at (866) 421-6223 (may incur telephone charges if initiated outside the U.S.) or email her at IRFP_survey@abtassoc.com. You may also contact John Tsapogas, who is overseeing this study at NSF, with any questions or comments: jtsapoga@nsf.gov.

Thank you for your assistance. We greatly appreciate your time and consideration.

Appendix F: Comparison of IRFP Applicants to SDR

A comparison of all IRFP applicants to the Survey of Doctoral Recipients (SDR) provides a context for understanding the career outcomes of the pool of IRFP applicants relative to a nationally representative sample.

The SDR is a longitudinal survey of a nationally representative sample of science, engineering, and health (SEM) doctorate recipients. Details of the sampling frame and how the SDR data (2006 and 2008 waves) and the analyses conducted are provided in Appendix D.

Given the overall purpose of the SDR (to describe general characteristics of doctoral education and early post-graduation employment for doctoral recipients), it was not designed specifically to address questions that might be important for the IRFP evaluation, including, for example, whether U.S. doctorate recipients in STEM fields co-author research publications with foreign collaborators. The only SDR question related to that type of outcome asked SDR respondents whether they had worked with individuals in countries outside the U.S. Other survey questions address more general career outcomes, specifically broad measures of employment, research productivity, and faculty rank and tenure for those working at institutions of higher education (IHEs).

Findings should be interpreted with an understanding that there may be uncontrolled initial differences between those who applied to IRFP and who responded to the SDR. Comparisons between survey data from the SDR and from IRFP fellows are descriptive in nature. The analyses reported in this appendix can take into account (that is, statistically control for) the amount of time that has elapsed between when respondents earned their degrees and completed a survey, but the analyses cannot account for differences in prevailing conditions at the time data were collected from IRFP applicants and SDR respondents; specifically, there may well be factors related to economic conditions and employment that differ between the years during which the SDR respondents completed surveys (2006 and 2008), and when IRFP fellows completed surveys in 2011. Also, the SDR excluded individuals living outside the U.S., whereas the IRFP did not. Finally, because it was not possible to identify individual IRFP applicants in the SDR sample there could be overlap between the samples that renders the groups non-independent, but this overlap would be relatively small.

Comparisons between SDR respondents and IRFP applicants were limited to SDR respondents who had completed a doctoral degree by the reference date specific to that SDR wave (April 1, 2006 in SDR 2006; October 1, 2008 in SDR 2008); to IRFP applicants who had applied for IRFP prior to 2008 (N=950; 379 awarded and 571 unfunded). In addition, analyses controlled for gender, whether or not an individual was a member of an ethnic or minority group traditionally under-represented in STEM fields (URM), field of study for the first doctorate, and the number of years between receipt of first doctorate and the reporting year of outcomes.

Findings: IRFP Applicants vs. SDR Respondents

The comparison of estimates on career outcomes of IRFP applicants to the national estimates suggests that not only are they more likely to be engaged in international collaborations, they also

are a qualified pool of researchers, who go on to successful careers. IRFP applicants (including both funded fellows and unfunded applicants) were more likely to be engaged in international collaborations. IRFP applicants were also more likely to work in their current job with individuals in countries other than the U.S. (66 percent) than the typical STEM doctoral recipient (33 percent), a large and statistically significant difference (Exhibit F.1). Also, IRFP applicants reported having statistically significantly more publications and patents than SDR respondents (11 and 5 publications, respectively, no exhibit).[24]

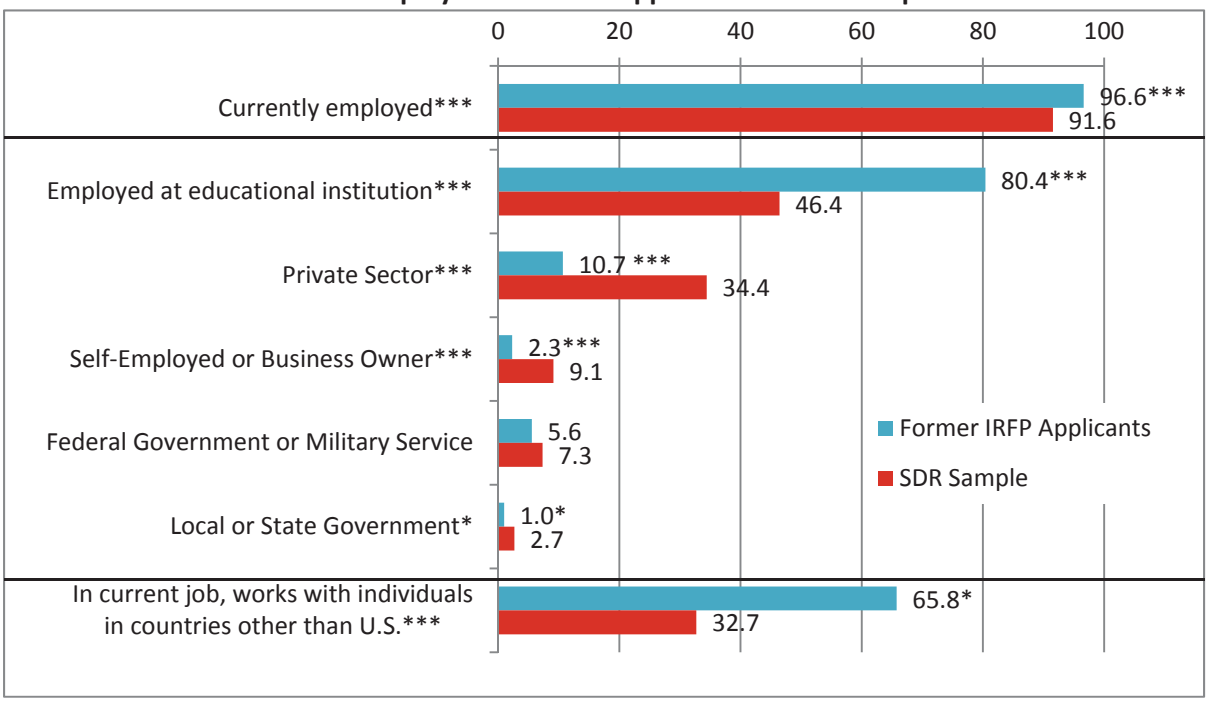
Former IRFP applicants had held, on average, a greater number of postdoctoral fellowships (1.6) than U.S. science and engineering doctoral recipients as a whole (.58), a statistically significant difference (no exhibit).[25] This finding is not surprising: by virtue of having applied to the IRFP program, these individuals were seeking a postdoctoral appointment, and the fact that the IRFP program supports an *international* postdoctoral appointment is likely to contributing less to this difference than is the difference between STEM doctorates who pursue a postdoc (domestic or otherwise) and those who do not.

Exhibit F.1 illustrates the differences in employment circumstances between former IRFP applicants and the SDR sample. Although most former IRFP applicants and most STEM doctoral recipients in the U.S. were employed during a specified reference week, former IRFP applicants were more likely to be employed (97 percent) than the average STEM doctorate (92 percent), the difference of 5 percentage points was statistically significant. Statistically significant differences were also seen in the employment sectors. Specifically, former applicants were much more likely to be employed by an educational institution. Former applicants were less likely than the average STEM doctoral recipients in the U.S. to work in the private sector, local or state government or to be self-employed or a business owner. Former applicants were more likely to work for a type of employer other than those listed.

[24] Statistical models controlled for the different time periods about which respondents reported publications.

[25] The measure of the number of postdocs for IRFP fellows included the IRFP postdoctoral fellowship. For example, a fellow reporting 2 postdocs had one postdoctoral fellowship in addition to his/her IRFP postdoc. For comparisons of the number of postdocs held since receipt of first doctoral degree, the SDR 2006 wave of data were used as these data were not available in the 2008 wave (IRFP N=950 Missing=0; SDR N=30,802 Missing=15).

Exhibit F.1: Characteristics of Employment of IRFP Applicants and SDR Respondents



*p<.05, **p<.01, ***p<.001

EXHIBIT READS: 96.6 percent of former IRFP applicants were currently employed during the reference week (October 1, 2010) compared to 91.6 percent of SDR respondents (whose reference week was October 1, 2008). This difference of 5.1 percentage points was statistically significant (p<.001).

Currently employed: This item was answered by former IRFP applicants (N=950 Missing=0) and by SDR 2008 respondents who had completed a PhD by October 1, 2008 (N=29,974 Missing=0).

Private Sector, Self-Employed, Federal Government or Military Service, Local/State Government: This item was answered by all former IRFP applicants who were employed as of October 1, 2010 in a non-postdoctoral position (N=723, Missing=0) and by SDR 2008 respondents who had completed a PhD by October 1, 2008 and who were employed during the week of October 1, 2008 (N=26,134, Missing=0). Items from which these data derive differed slightly between the IRFP Applicant Survey and the SDR 2008; thus, Local Government (city, county, school district) and State Government (including state colleges/universities) were combined into a single category for both groups; and U.S. Federal Government and U.S. MILITARY service, activity duty or Commissioned Corps (e.g., USPHS, NOAA) were combined for both groups.

In current job, works with individuals in other countries: This item was answered by former IRFP applicants who were employed during the week of October 1, 2010 (N=912, Missing=0) and by SDR 2006 respondents who had completed a PhD by April 1, 2006 and were employed during the week of April 1, 2006 (N=27,119, Missing=0). This item was not included in the SDR 2008 wave.

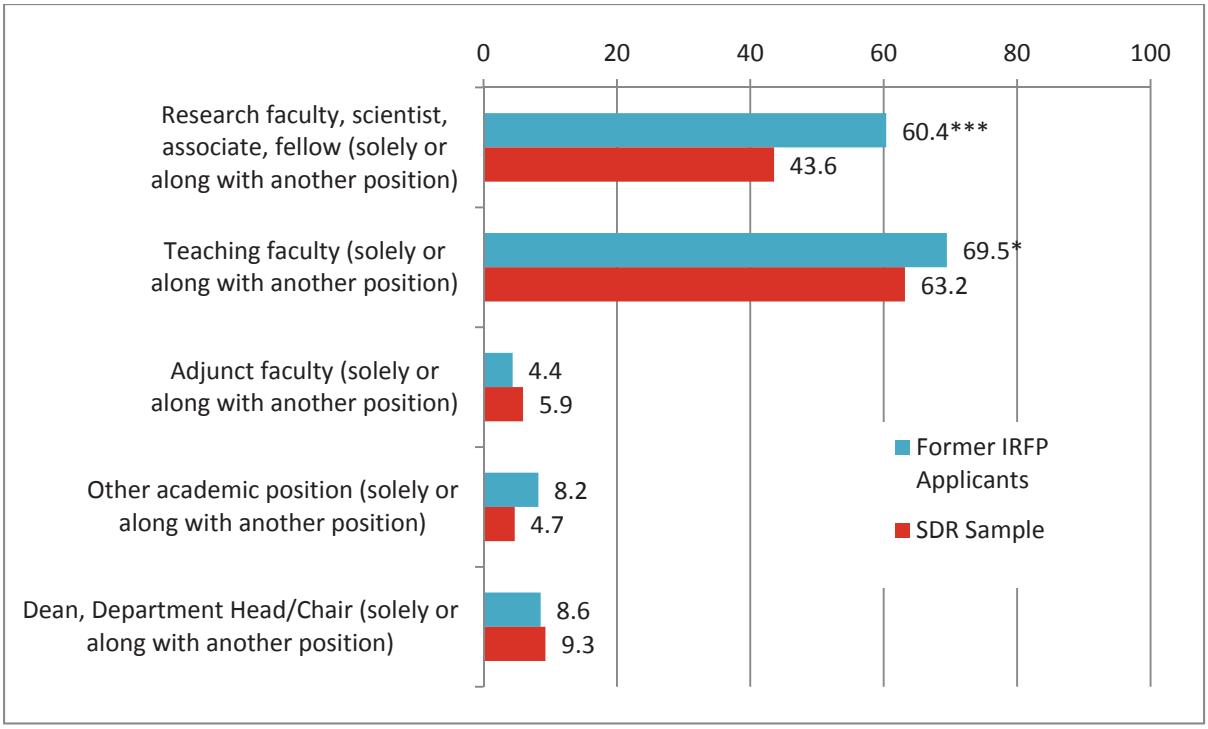
SOURCES: IRFP Applicant Survey–Items C9, D1c, D3, and D4. SDR 2008–Items A1, A11, and A12 and SDR 2006–Item A27.

Among those individuals who were employed in educational institutions (other than a preschool, elementary or secondary school or school system), a greater percentage of former IRFP applicants had earned tenure (66 percent versus 54 percent, no exhibit), a statistically significant difference. . However, among respondents working in this type of educational institution, an equal percentage of former applicants and SDR recipients were in tenure track positions (e.g., assistant, associate, or full professor) (93 percent each, no exhibit).

Among those individuals employed in educational institutions, respondents often reported that they occupied multiple roles with varied teaching, research, and administrative responsibilities (Exhibit F.2). A statistically significantly higher percentage of former IRFP applicants than SDR respondents reported that they held an academic position as a research faculty member, scientist, associate or

fellow (other positions could also be held concurrently) and held an academic position as a teaching faculty member (other positions could also be held concurrently). Other differences were not statistically significant.

Exhibit F.2: Types of Academic Positions held (Solely or along with Another Position) by IRFP applicants versus SDR Respondents



*p<.05, **p<.01, ***p<.001

EXHIBIT READS: Among those working at an educational institution, 60 percent of former IRFP applicants versus 44 percent of SDR 2008 respondents held a research position (solely or concurrently with another position);) this difference was statistically significant.

NOTES:

The academic positions are not mutually exclusive*:* Individuals could select more than one response. For example, individuals could hold a research faculty position and a teaching faculty position simultaneously.

These items were answered by former IRFP applicants (fellows had to have completed their IRFP fellowship, including any U.S.-based "re-entry period," as of October 1, 2010) who were working at an educational institution (other than in a postdoctoral position) during the week of October 1, 2010 and who did not report working in a preschool, elementary, middle, or secondary school or system (N=551, Missing=0) and by SDR respondents who had completed a PhD by October 1, 2008, who were working in an educational institution during the week of October 1, 2008, and who did not report working in a preschool, elementary, or secondary school system (N=11,773, Missing=0).

SOURCES: IRFP Applicant Survey–Item C9, D1c, D2, D2a and D2b. SDR Survey 2008–Item A1, A12 and A14.